60p

YOUR COMPUTER

MARCH 1982

Vol.2 No.3

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EDITORIAL

THIS IS THE FIRST anniversary of the ZX-81. In the year since it was launched more than 250,000 of them have been bought and somewhat more than half of those have stayed in Britain. Sinclair Research has been subject to a certain amount of criticism, mainly for poor quality control and customer relations, but no one can deny that the company has done computing a great service. The 250,000 who have bought ZX-81s would have had to wait for a long time for another manufacturer to match the Sinclair price.

The anniversary of the launch of the ZX-81 falls in the same month that the BBC has announced it has had to raise the price of the BBC Microcomputer to £299 for the basic model. The £299 might still represent good value for money, but for the ZX-81 user looking for a new computer it is probably too great a jump from the £69.95 price of his first machine.

There are plenty of other companies ready to fill the gap. The most notable of these is Commodore with the Vic-20 at £189.95. It is not a particularly spectacular machine, but the price is right and it does offer most of the things a home user needs — a good Basic, colour, sound and the ability to take plug-in games and program packs, to save the recurring problem of loading from cassette.

In our view it would be a shame if Sinclair were to succumb to the same set-backs suffered by his forays into the pocket-calculator and digital-watch markets. In both cases he was the first on the market and proved that a massive demand existed for the new and untried products he had created. Within a matter of months he was knocked out of the market by superior American and Japanese technology.

If, by the end of this year, it turns out that all Sinclair has managed to do is prime the U.K. market for U.S. and Japanese home computers it would, in retrospect, look as though Sinclair has been less of a help to an otherwise beleaguered Britain than we had at first imagined. We do not want to appear too chauvinistic, and we believe strongly in the merits of free trade, but that does not mean we should be too casual about our own interests.

When *Your Computer* interviewed Clive Sinclair in August 1981, he said, when talking about his experiences with pocket calculators and digital watches, that he did not intend to make the same mistake again. There have, in recent months, been many rumours that a ZX-82 is on its way.

Let us hope firstly that Clive Sinclair does launch a ZX-82 and secondly, that when he does it is not a replacement for the ZX-81, as the ZX-81 was for the ZX-80, but that he has carefully designed his new computer to fill the gaping hole between the ZX-81 and the BBC Microcomputer. Then ZX-81 users, and all the ZX-81 support companies which have sprung up in the last year, will have something to look forward to. ■

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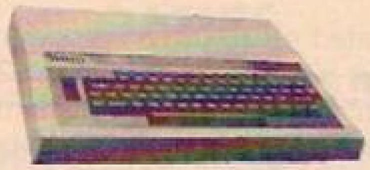
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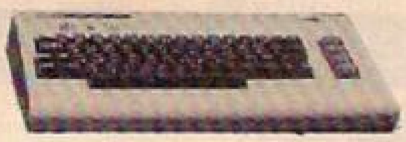
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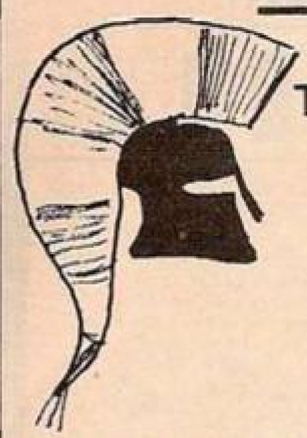
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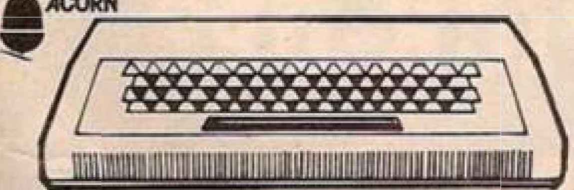
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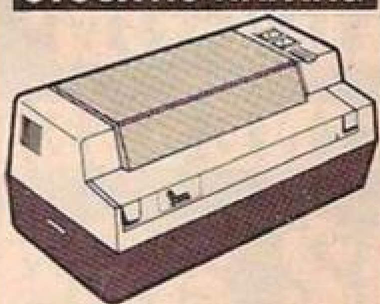
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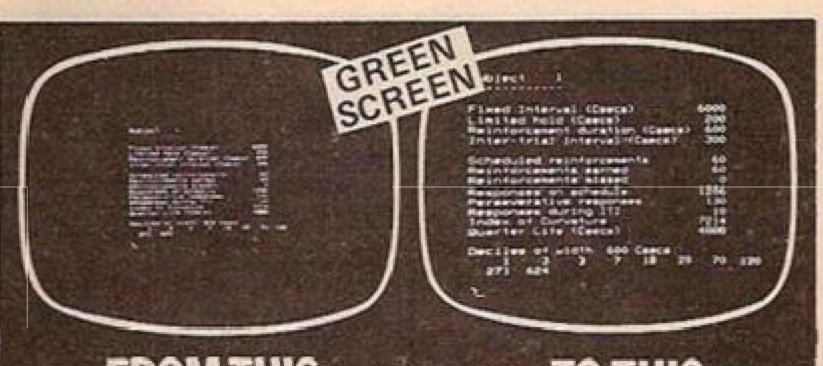
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ZX-81 ANIMATION

There are a few errors in my article "Smooth Animation for Games" in the February issue of *Your Computer*. In figure 1, line 103, the last instruction should be JR L4 (not JRL4). The first instruction in line 104 should be

L3LD A,(DE)

i.e. without a space before "(DE)".

In figure 2, the second byte should, of course, be 0E (not OE). In the last paragraph of text on page 52, the number to be Poked in locations 16515 and 16516 ranges between 1 and 791 (not 79, as printed).

John Watson,
Old Basing,
Hampshire.

SPEEDY VIC

I was interested to read the review by Tim Hartnell on the BBC Micro. The results of the counting-speed test were also intriguing. I own a Vic-20 and was curious to find out what my box of chips could do. The program I ran was as follows:

```
1 PRINT "CLR/HOME"
5 PRINT "CRSR6spaces rightSPEED
  TEST"
10 TI$="000000"
20 FOR N=1TO1000
30 PRINT "S" (note: cursor home)
40 PRINT N:NEXT
50 PRINT TI$
```

It took 11 seconds, compared to 14 seconds reported for the BBC Micro, to count and print to 1,000.

I realise that the form of the instructions can influence the running time of the program. For example, if the statement in line 30 is altered to CLRandHOME then the program takes 25 seconds to complete. Therefore I make no special claim for the Vic-20.

I must congratulate *Your Computer* on its content and presentation, both very appropriate to a beginner in computing like myself.

Stephen Clark,
Glasgow.

ZX-81 SCREEN

The program by Nigel Moats for Poking on to the bottom two lines of the screen on the ZX-81 — Software File, November 1981 — was quite long and not entirely crash-proof.

By Poking into DF-SZ it is possible to print on the bottom two lines of the screen. Poke 16418,0 will allow you to do this: it must be included in a program, and Input must not be used until you Poke 16418,2 or else the computer will crash.

The screen can also be shortened by Poking address 16418. Poke 16418,11 will only allow you to print on the top 12 lines, and Poke 16418,23 will only allow you to print on the top line.

Here is a short program that allows you to input a string and then print on the bottom line of the screen.

```
10 LET A$=""
20 POKE 16418,0
30 PRINT AT 23,0;A$
40 PAUSE 100
50 POKE 16418,2
60 INPUT A$
70 GOTO 20
```

I have also written a short machine-code routine which will allow you to fill the screen with CHR$ 8 when called by USR. This subroutine fills the screen within a second in slow mode, and any character can be used by a simple alteration. The machine code can be Poked into a dummy Rem statement or into RAMtop. It only takes up 11 bytes, and should be called by RAND USR (starting address).

Phil Evans,
Newport,
Shropshire.

ZX-81 screen-fill routine.

Dec	Hex	Instruction	Notes
6,176	06,B0	ldB,176	
62,8	3E,08	ldA,8	The 8 here is to CHR$ to be printed change this to change the CHR$.
215	D7	rst 16	
215	D7	rst 16	Call print routine.
215	D7	rst 16	
215	D7	rst 16	
16,250	10,FA	djnz 250	Is it the end? If not jump back to 2nd line.
201	C9	Ret	Return to Basic.

BBC SERVICE

Since I am thinking of buying a BBC Microcomputer I was pleased to read your favourable conclusions concerning its qualities — *Your Computer*, January 1982. I am afraid, however, that the sale of this microcomputer might be hampered by the apparent lack of commercial interest shown by the BBC.

As the BBC Micro promised to offer excellent value for its price, I decided more than two months ago to ask for general information as well as an order form. To my disappointment I have not yet received a reply from the manufacturer.

Fortunately I happened to obtain the general information required from one of my colleagues. I made up my mind to buy model B of the micro, but to be sure to order a complete system in working order I still need more details on the contents of the initial package.

I wonder whether the BBC is simply unwilling to take any notice of my requests, or whether it has decided not to sell its attractive product abroad. I fear that this lack of interest might make its influence felt on the after-sales service as well, and this factor will no doubt discourage potential customers from the Continent.

Can anyone tell me how to get in touch with the BBC Microcomputer sales service, before my enthusiasm for the British microcomputer wanes?

D H Joziasse,
Alphen,
The Netherlands.

SOUND-BOX

Readers may have had difficulty in obtaining the transistor for my ZX Sound-Box project — Software File, December 1981. I used an AC169 in the prototype, but the actual number is not too important as long as it is PNP. As an alternative I suggest an AC126 which is available from Watford Electronics, 33/35 Cardiff Road, Watford, Hertfordshire.

I would also like to mention an error in the article. Where A4 is stated, it should read A3. Although connection to A4 will not damage the computer in any way, it will change the port address. To correct the fault simply remove the connection from the computer or edge connector and replace it on the A3 line.

J Chalmers,
East Grinstead,
West Sussex.

VIC-20 INPUT

I am the proud owner of a Vic-20 and, so far, I am quite pleased with its performance. My machine does have a few bugs though, and I wonder how many others are like it. I assume that the problems which I have are caused by the Vic, rather than by my lack of knowledge, so perhaps this letter will inform others.

The first bug is in the Input statement. The Vic manual says that a message can be put in quotes between the statement Input and the variable name. On my Vic this is only valid if the message can be printed on one screen line. Should the message run on to a second screen line then the Vic thinks that the message is part of the input. For example,

INPUT "The Voltage"; V

runs to perfection, but

INPUT "The number of volts at A"; V

produces a Redo From Start error message because the Vic inputs not only the number, when return is pressed, but also the message "The number of volts at A" which, of course, cannot be input to a numerical variable. If one tries

INPUT "The number of volts at A"; V$

then it runs but on printing V$ one sees that V$=The number of volts at A 6 — if 6 was entered in response to the prompt.

I have devised two ways to surmount the problem, although there may be others. You can set the cursor to a new line either by means of the cursor controls after the prompt, or by putting a cursor movement in the Input statement. This effectively puts the information being typed in on a new line.

Alternatively, you can put the message in a Print statement before the Input statement and keep the Input statement to one screen line.

The second problem concerns string length. The manual declares that strings may contain up to 255 characters. I agree, but just try to type in more than 88 at a time. The Vic won't have it. If I type in 89 characters — i.e., more than four screen lines — then only the 89th character is accepted on pressing Return. The Vic won't accept more than four lines at a time. The only way my Vic will do this is to input the string in four-line parts, and then add them together as in the following routine.

```
1 B$="" : REM EMPTY STRING
5 INPUT A$
10 B$=B$+A$
15 PRINT CHR$(147) REM CLEAR
   SCREEN PRINT B$ PRINT
20 PRINT"PRESS 1 TO ENTER
   MORE" PRINT
25 PRINT"PRESS ANY OTHER KEY
   TO END" PRINT
30 GET Z$ IF Z$="" THEN 30
35 ON VAL(Z$) GOTO 5
```

In this way the string variable B$ is slowly filled with information in four-line chunks of A$, and the maximum 255 characters can be input. There may well be other methods of doing this involving less effort, but I have not found them yet.

Is my Vic unique in having these two bugs, or have I really missed something in the manual?

David Robinson,
Llantwit Major,
South Glamorgan.

LIFEBOAT APPEAL

I am the chief fund-raiser for the Appledore Lifeboat Station and we sell about £7,000-worth of RNLI souvenirs, etc., each summer. I run an open-air stall on Westward Ho! promenade selling some 70 different items.

For the last year we have been keeping details of turnover each hour, together with weather conditions and tide. The latter is important as there is no sand at high water, and so more people on the Promenade and more sales. The stall is open on about 80 days during the season.

I have just acquired a ZX-81, on which I would like to run a program from which we can extract the best times and the best days, with coded weighting values for weather and tide. Or, perhaps, we would compute an average take between three and four o'clock on Sundays when the band is playing.

Are there any local ZX-81 users who would be willing to help?

Colin Lowry,
Buckleigh House,
Westward Ho!,
Devon.

Education on the ZX-81

SCISOFT, A software company formed by a group of science teachers last year, has launched two educational programs for the Sinclair ZX-81. Markbook, £4.50, is a menu-driven utility program for teachers which will sort lists of pupils into alphabetical, form or rank order.

Revise at £27.95 is a package devised for pupils studying for O level physics. More details from Scisoft, 5 Minster Gardens, Newthorpe, Eastwood, Nottinghamshire.

Super Vic and CBM 64

COMMODORE International Ltd plans to launch two new microcomputers this year, the Super Vic and the Commodore 64. The Super Vic is a 16K full-colour, 40-column micro expected to cost about £212. The Commodore 64 is also a full-colour, 40-column micro, but has 64K of in-built memory and should cost about £315.

In addition, Commodore is planning to introduce Ultimax, a combination of video game, microcomputer and music synthesiser. A computer membrane keyboard allows the video game to be used as a micro with a built-in memory, while a second keyboard enables the Ultimax to function as a music synthesiser which can duplicate the sounds of a piano, harpsicord, clarinet and other musical instruments.

None of these three machines is likely to be available in Europe until later in the year, or early 1983, but they will be on display at the Hanover Fair, West Germany, in April, and the Pet Show in June.

Top of class in software

A RECORD entry is expected for this year's national computer software competition for schools and colleges throughout the U.K.

Run by the University of Kent, the competition is designed to foster an awareness among schools of the industrial and commercial uses of computer systems.

The competition is divided into two classes, one for students under 16 and one for students under 19. Winning students in each category will be awarded a £400 cash prize and the computing department of the winner's school or college will receive up to £1,000 of equipment.

Experts confounded as machine out-thinks grandmaster Nunn

WORLD CHAMPION chess computer the Chess Champion Mark V caused an upset during a man-versus-machine chess problem-solving contest in Brighton, East Sussex. The Mark V not only beat John Nunn — the current British chess problem-solving champion — five times out of six, it also found three correct solutions to one problem. A chess problem is supposed to have only one possible solution.

The problem with the three solutions was originated by a leading Russian chess-problem expert L Zagorujko in 1972. The problem has appeared in newspapers and magazines around the world, but no-one had found a solution other than the one proposed by Zagorujko.

The Zagorujko problem was one of six set before Nunn and the Mark V by Barry Barnes, vice president of the problem commission of the World Chess Federation. Nunn was unable to find a solution to the problem, but the Mark V confounded the experts by finding Zagorujko's solution and two alternatives of its own.

Andrew Page, U.K. general manager of SciSys which manufactures the Mark V, said: "It shows that chess computers have reached a level of sophistication which makes them essential for organisers of chess competitions, and for chess players who want to verify results or analyse matches.

"There are certain areas of chess in which computers are already capable of deeper analysis than humans. The day of the unbeatable chess computer is fast approaching".

The Chess Champion Mark V is made in Hong Kong by SciSys and distributed in the U.K. by Vulcan Electronics, 200 Brent Street, Hendon, London NW4. Telephone: 01-203 5161.



Dr John Nunn, right, and the Mark V ponder the Zagorujko problem, watched by international master David Levy.

All the fun of the Fair

PHAROAH HUGHES Associates Ltd is offering a package deal for the Computer Fair, which is being held at Earls Court exhibition centre from April 23 to 25.

Under the deal, visitors to the Computer Fair will be able to stay in twin-bed rooms at either the three-star St James Hotel or the two-star Cranley Gardens Hotel. Continental breakfast and admission to the Fair is included as part of the deal. The package costs £15.30 per person for each night at the three-star hotel and £13.80 a night for the two-star hotel.

In addition, Pharoah Hughes will arrange reduced rate second-class return rail tickets for its package deal customers.

Sponsored jointly by *Your Computer* and *Practical Computing*, the Computer Fair will cater for all microcomputer users from the home enthusiast to the small businessman.

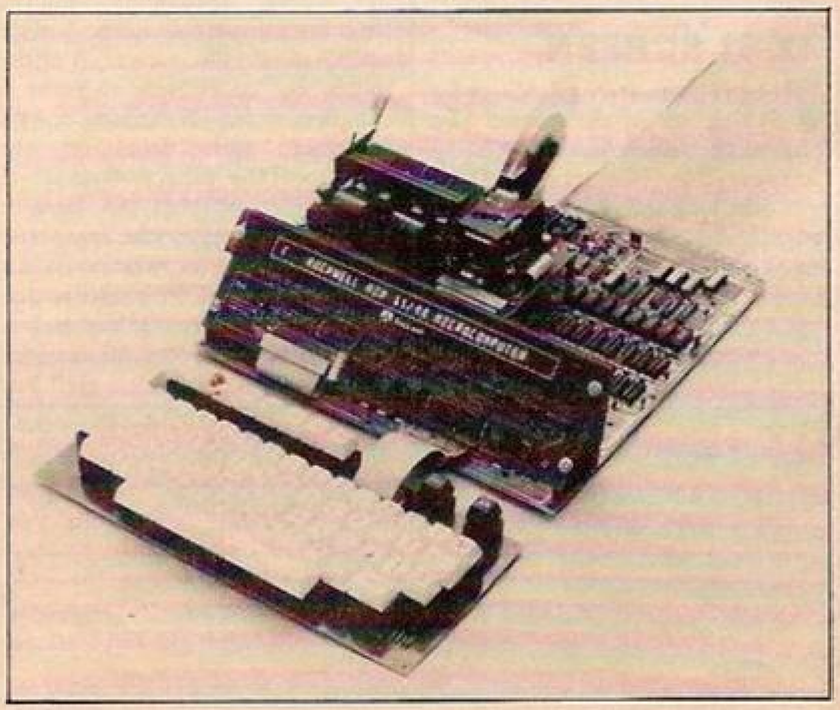
More information about the Computer Fair package deal is available from Pharoah Hughes Associates Ltd, Lamb House, Church Street, Chiswick, London W4 2PD. Telephone 01-995 8995.

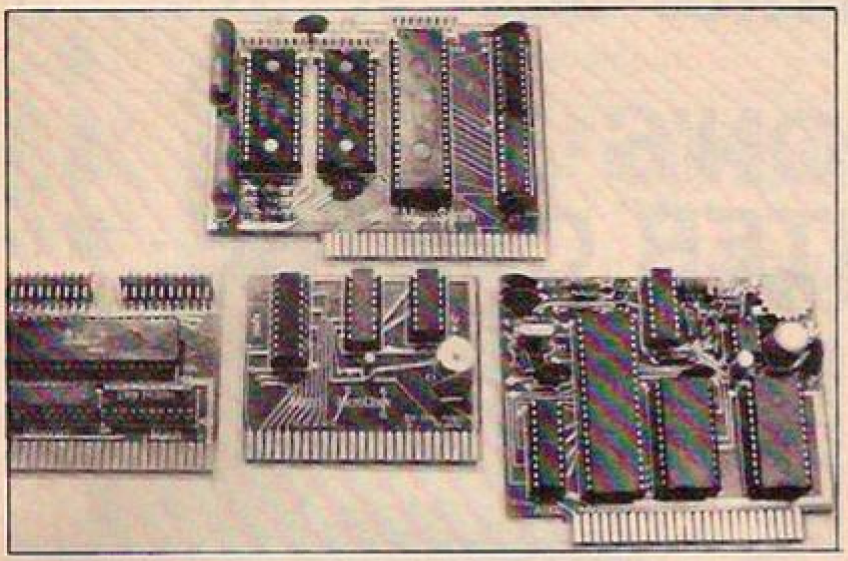
Adventure in machine code

ADVENTURE C is the third in a series of Adventure games written entirely in machine code by Artic Computing. An alien cruiser is on a slave mission with the aim of capturing humanoids and replacing their brains with microchips. You must escape from the cruiser if you can. The program is available on cassette and costs £9.

Artic's second new game is ZXChess II which plays on seven levels and costs £15. The fastest response time is one second, says Artic, and the first five levels play within three minutes of a move. The game also contains an analysis routine. Artic Computing, 396 James Reckitt Avenue, Hull, North Humberside.

The Rockwell Aim 65/40 microcomputer with 40-column vacuum fluorescent display has been launched by RCS Microsystems. Designed principally for laboratory instrumentation and software development applications, the Aim 65/40 includes 48K RAM, 32K ROM and user RS-232, and an on-board 40-column printer with full graphics capability. Software development is supported in assembler, Basic, PL/65 and Forth languages. A monitor provides a text editor with screen editing, monitor-command-string processing and symbolic debugging. Full details from RCS Microsystems Ltd, Gresham House, Twickenham Road, Feltham, Middlesex TW13 6HA. Telephone: 01-898 4761.





Four peripheral cards for the Apple II and III have been launched by March Communications Ltd. MicroClock is a real-time clock with registers ranging from tenths of seconds to leap years. MicroTalker is a speech synthesis card using the National Semiconductor Digitalker chip set, while MicroSynth is a sound and music synthesiser card which uses the AY-3-8912 device. MicroPort consists of a dual eight-bit parallel input/output card. More detailed information about the cards can be obtained from March Communications Ltd, 14-16 Manchester Street, Liverpool L1 6ER. Telephone: 051-236 2000.

2K EPROM for Sinclair

AN EPROM card for the ZX-80/81 has been developed by Orme Electronics. The card uses a 2716 EPROM with a 2K capacity for machine code and is designed to work in the space immediately above the Sinclair internal ROM. An additional 6K of space is available for future development.

The EPROM card has an edge connector and can be fitted to either the ZX-80 or the ZX-81, though the ZX-80 has to be modified by cutting the track leading to pin 20 of the ZX-80 ROM and soldering a 680 resistor across the breach. A wire then must be connected from the resistor to the 23B position on the edge connector.

The card is supplied with a pre-programmed EPROM which contains 11 utility-type programs including a renumbering program and a program for converting decimal to hexadecimal. The EPROM also includes the game Life which simulates the survival, growth or eventual death of a colony of cells.

The EPROM card and the programmed EPROM cost £17.95 and are available from Orme Electronics, 2 Barripper Road, Camborne, Cornwall TR14 7QN.

Basic games on new cassette

MICHAEL ORWIN has released a second cassette of programs for the ZX-81. Cassette 2 contains 10 games in Basic for the ZX-81 with 16K RAM. The games include Othello, Laser Bases, Pontoon, Rectangles and Word Mastermind. Side A and side B contain the same programs, but in a different order.

The cassette costs £5 from Michael Orwin, 26 Brownlow Road, Willesden, London NW10 9QL. Telephone: 01-965 4676.

BBC Micro price rises

THE PRICE of the BBC Microcomputer increased by £75 to £299 on February 1, while the cost of the enhanced model rose from £335 to £399.

All customers who placed orders before February 1 will be charged at the old rate, but orders received after that date will be charged the new prices.



Chris Curry, managing director of Acorn Computer Ltd, which is manufacturing the BBC Microcomputer under licence, said: "The original pricing structure has proved to be too optimistic, given the need for particularly rigorous tests.

Acorn is confident, however, that it has solved the flawed-microchip problem that has delayed production of the BBC Microcomputer. The 12,000 outstanding orders should be cleared by the end of March.

Cost of Atom ROM cut

WILLOW SOFTWARE has cut the price of its 4K utility ROM for the Acorn Atom. The ROM, which provides 18 additional facilities for the Atom, is now being retailed for £26 plus VAT and post free. Contact Willow Software, PO Box 6, Crediton, Devon, EX17 1DL.

Graphics package that draws on your skill to create on screen

THE BIT STIK creative-graphics system designed and produced by Robocom Ltd enables microcomputer users to draw multi-coloured sketches, diagrams and graphics without having to input instructions via a keyboard. A DOS 3.3 disc allows the user to draw directly on the video screen using the Bit Stik as the only input.

A comprehensive menu can be called at the edge of the screen and accessed by pointing to the required items with the drawing cursor. The menu provides pallet facilities for automatic lines, arcs and circles, four line types in six colours and a variable nib for colouring and lettering.

An automatic paint facility allows line drawings to be coloured using up to 16 colours. Mode selections for the menu include Zoom, for detailed drawing and viewing, Copy, for reducing and compiling, and Find, which locks on to a particular point.

A secondary menu can be used to save and load drawings on to floppy disc, enabling the user to build up a file of drawings. Other selections allow the user to position text at any scale, angle or colour in a drawing, while Animate permits the dynamic recording and replaying of a series of drawings.

In addition, a lock function provides two angle and two grid locks to assist in the drawing of three-dimensional views and grid-based layouts as used in typography and circuit diagrams. If required, an X,Y selection displays the co-ordinates of the cursor on the video screen while drawing.

Two pages are available at any one time for direct drawing or to hold components of the work in hand. Each page can hold up to 16,000 pages of information which can be viewed by zooming in on specific areas. A memory counter indicates the available workspace while a compress function allows drawings to be squeezed into the minimum memory space.

A short interface program allows paper copies of the drawings to be produced on any X,Y plotter. The resolution of the drawings is limited only by the capabilities of the plotter, not the original video page, says Robocom.

An illustrated user manual contains instructions and examples for using the Bit Stik, as well as information on writing programs and using drawings in other routines. The Bit Stik can also be used without any software as a precision games controller for all paddle-operated games.

At present, the Bit Stik system is only available for use with a 48K Apple system complete with DOS and colour or black-and-white monitor. Depending on demand, Robcom plans to produce interface modules and modified software for other microcomputers.

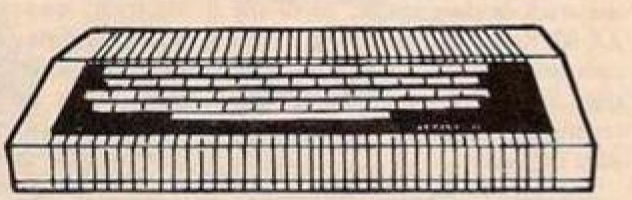
The Bit Stik graphics system costs £185 plus VAT, post and packing free, from Robcom Ltd, Cil Trading Estate, Fonthill Road, London N4.



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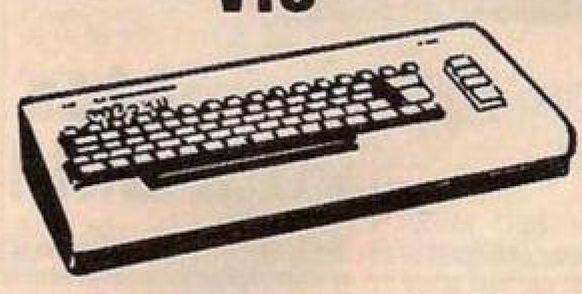
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Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. Each month we will devote the page to new ideas from local clubs. We would like to hear of anything which has made a club a success, or of any projects or programs you are developing.

ZX schools' group yields support and information



Educational Users' Group pioneer Eric Deeson (left) tells Brendon Gore of the difficulties in persuading teachers to get down to writing programs for their micros.

WITH POLITICIANS promising to put a microcomputer in every secondary school, and the BBC launching its computer-literacy series, a growing number of schools have become aware of the need to offer computing courses in the curriculum. EZUG, the Educational ZX-80/81 Users' Group, is committed to encouraging more schools to use the ZX-80/81 in the classroom.

Founded by Eric Deeson in December 1980, with support from Microcomputer Users in Secondary Education, MUSE, EZUG is a self-help group of teachers, pupils and parents. It is a non-profitmaking organisation with more than 1,000 members in more than 20 countries including the Philippines, India, Malawi and Australia.

At the centre of EZUG's activities is a bi-monthly newsletter which consists of news, reviews, tips on programming, solutions to hardware and software problems and answers to members' queries. Eric Deeson started the newsletter as a guide to writing programs for the MUSE software library with the aim of developing a section of ZX-80/81 programs suitable for use in both primary and secondary schools.

The primary task

This is still the newsletter's primary task, but it now includes competitions, questions on insurance and a host of advice for Sinclair users in education. A year's subscription costs £2.50.

The MUSE library, which distributes software to members on a commission basis, has about 100 programs in stock, mainly for the 380-Z, Pet and Apple. This gives MUSE members access to a large number of programs designed for use in schools.

The copyright for each program is retained by the author who is free to distribute his program elsewhere, providing he does not undercut the MUSE price.

EZUG's policy of encouraging members to write software for the MUSE library is starting to pay dividends. About 50 programs have been submitted to Eric Deeson for inclusion in the ZX-80/81 section of the MUSE library, most of them arriving in the last two or three months.

Of these programs, 14 have been accepted, two were withdrawn by the authors and 14 were returned for rewriting. Only 10 were rejected while another 10 are still in the pipeline. The accepted programs include Taxi, which simulates the problems encountered in running a taxi business, and Titrations, which determines the quantity of a given chemical in solution. Programs sent to EZUG are examined by Eric Deeson and two or three independent assessors.

"The criteria for assessment are very difficult to determine", admits Eric Deeson, "but none of the programs submitted so far has been rejected solely because of bad programming".

Ideally, says Deeson, potential contributors should adopt a two-person approach to educational software programs. A teacher who is not an expert programmer would benefit from collaborating with an experienced programmer and vice versa.

With primary school teachers constituting 30 to 40 percent of EZUG's membership, there should be no shortage of potential programmers. "Unfortunately, teachers, like other people, are often somewhat frightened of submitting their own programs to outside scrutiny", explains Deeson.

Reluctant encouraged

In a bid to encourage reluctant programmers, Sinclair Research has created an award scheme for educational ZX-81 software. Six ZX Printers will be awarded for the best programs accepted for the MUSE library by the end of March 1982. The programs will be judged by Eric Deeson, EZUG organiser, and Charles Sweeten, MUSE software librarian.

Criteria for assessment will include a program's acceptability for a specified educational role, novelty, the use of graphics where applicable and the standard of programming. Only MUSE members are eligible for the awards — the closing date for entries is February 27.

"The award scheme shows that Sinclair Research is now aware of the education market", says Eric Deeson. "The company is showing willing, though I would like to see it allocating some money to help with EZUG's printing costs".

EZUG's most recent venture was the publication of its *Directory of suppliers to the ZX market*. The *Directory* lists some 150 ZX suppliers and their products under eight classifications including national user groups, memory expansions, hardware add-ons and software. The *Directory* costs £1 and is available from EZUG, Highgate School, Birmingham B12 9DS. A second edition will be launched in six months, if there is sufficient demand. ■

Local society news

Glasgow

IAN WATT of 107 Greenwood Road, Clarkston, Glasgow G76 7LW has formed a ZX-80/81 Users' Group for the Glasgow area. "One of the club's main aims is to encourage computer literacy", says Watt. When the club is fully organised it hopes to include a section for the BBC Microcomputer. Anyone interested in joining the club should write to Ian Watt, or telephone 041-638 1241.

Cumbria

THE RECENTLY formed Furness Computer Club which meets at Dalton-in-Furness is looking for new members. Information about the club can be obtained from Arthur Gay, 24 Rusland Crescent, Ulverston, Cumbria LA12 9LX. Telephone Barrow (0229) 52854, between 6 and 7pm Monday to Friday.

Edinburgh

THE SCOTTISH Amateur Computer Society meets at the Claremont Hotel, Claremont Crescent, Edinburgh, on the first Wednesday of each month at 7.30pm. Members are encouraged to bring their own microcomputers to the meetings which usually include talks, demonstrations and education sessions for beginners. Visitors are always welcome. Further details from the secretary, Peter Lindsay, 1 Lower Gilmore Place, Edinburgh. Telephone 031-229 6841. ■

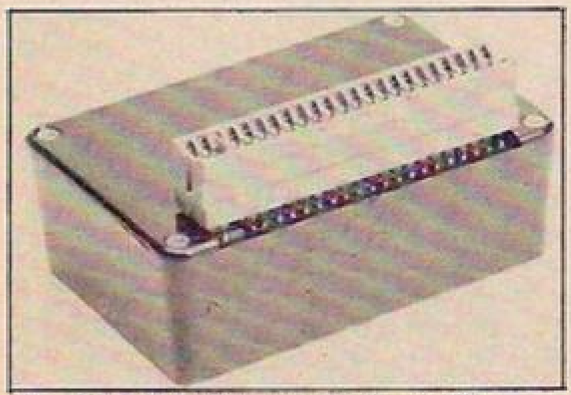
Stephen Adams tests and compares a clutch of seven of the main RAM packs on the market for reliability, expandability and value for money per kilobyte.

ONLY ONE of the review RAM packs was supplied without the 40-way edge connector needed to create the interface with the ZX-81 through its expansion port. These edge connectors are soldered directly on to the RAM's printed-circuit board. This means that the weight of the RAM pack and all its components pull the edge connector contacts away from the ZX-81. Also, when the keyboard is pressed at the edges, it tends to lift the back of the ZX-81 and the RAM pack with it. Both these instabilities can mean that laboriously-entered problems are lost.

The manufacturers use several methods to overcome these defects. One is to add a foam rubber strip just above the RAM pack edge connector. This foam strip, which is about 0.25in. thick, stops the RAM pack wobbling by creating a wedge. With this method, the RAM pack does not move unless firmly struck on the keyboard — as a small child might.

Two manufacturers have employed this solution, JRS Software and Hilderbay. Their RAM packs are identical, and are 2in. by 1.5in. including the edge connector.

The two 4K RAM packs — 3K of on-board RAM and the internal 1K of RAM — used



The JRS 16K RAM measures 2in. by 3in.

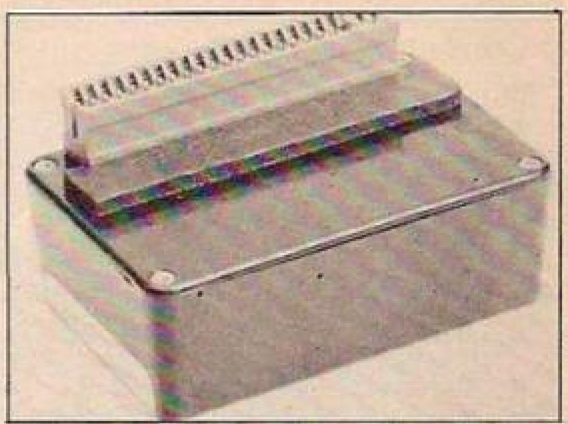
tighter edge connectors and were the most stable of all. The edge connector on the Audio Computers 32K RAM pack made it extremely difficult to use. The only way I could find to keep it steady was to pull the top of the RAM pack forwards and bind it to the top of the ZX-81 with a 6in. piece of insulation tape. This meant that the edge connector was held tightly against the ZX-81's expansion port. It also meant that the RAM pack could not even be used just after switching on the power and was certainly the worst case I encountered.

The Sinclair Research 16K RAM pack has no foam strip on its case, but by attaching a piece of foam to the ZX-81 and the RAM pack with double-sided sticky tape, you can make it immovable. It also emits an annoying hiss, absent in other RAM packs. This must be due to its use of a small transformer to produce the required voltages.

The Memotech 48K RAM pack was attached to the ZX-81 by a small board, holding the edge connector and a ribbon-cable connector. The ribbon cable connects to a similar printed-circuit board arrangement to connect to the RAM pack. As these boards are virtually weightless, they place no strain on the ZX-81 expansion port. The ZX-81 sits on a well in front of the hump of this RAM pack and this eliminates the problem caused by the keyboard flexing. A sticky pad is provided to hold the ribbon cable in place.

The power for almost all these RAM packs is produced by the Sinclair power pack, via the edge connector +9V line and the internal +5V regulator — the two exceptions are the Memotech and the Audio Computers RAM packs. Both these functioned satisfactorily, even when loaded with a motherboard and two extra boards.

The Memotech powers the ZX-81 separately from the RAM pack via a 3.5mm. plug on a 1ft. long cable which leaves the left-hand side of the hump. The hump contains two mains transformers fed from a filtered and fused supply. One transformer feeds the ZX-81, the other supplies the RAM pack with

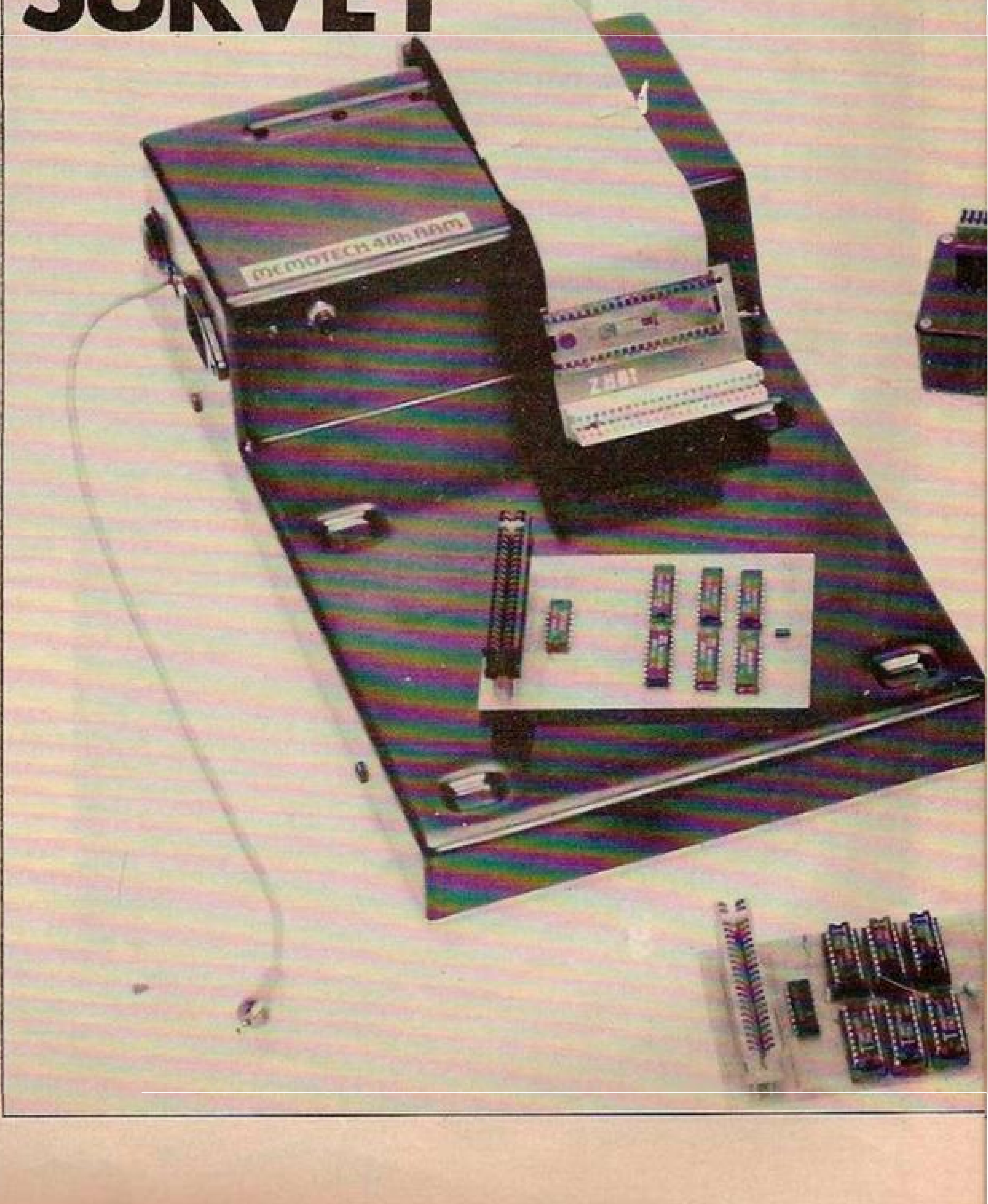


Hilderbay used a foam strip to stop wobble.

+12V. The 9V line to the ZX-81 will also run the Sinclair printer without any trouble.

The Audio Computers 32K RAM pack was supposed to run with the Sinclair power pack; it does not, though I did not try the modification to the power pack suggested in which you add 1.5m. of enamelled wire to a

ZX-81 RAM SURVEY

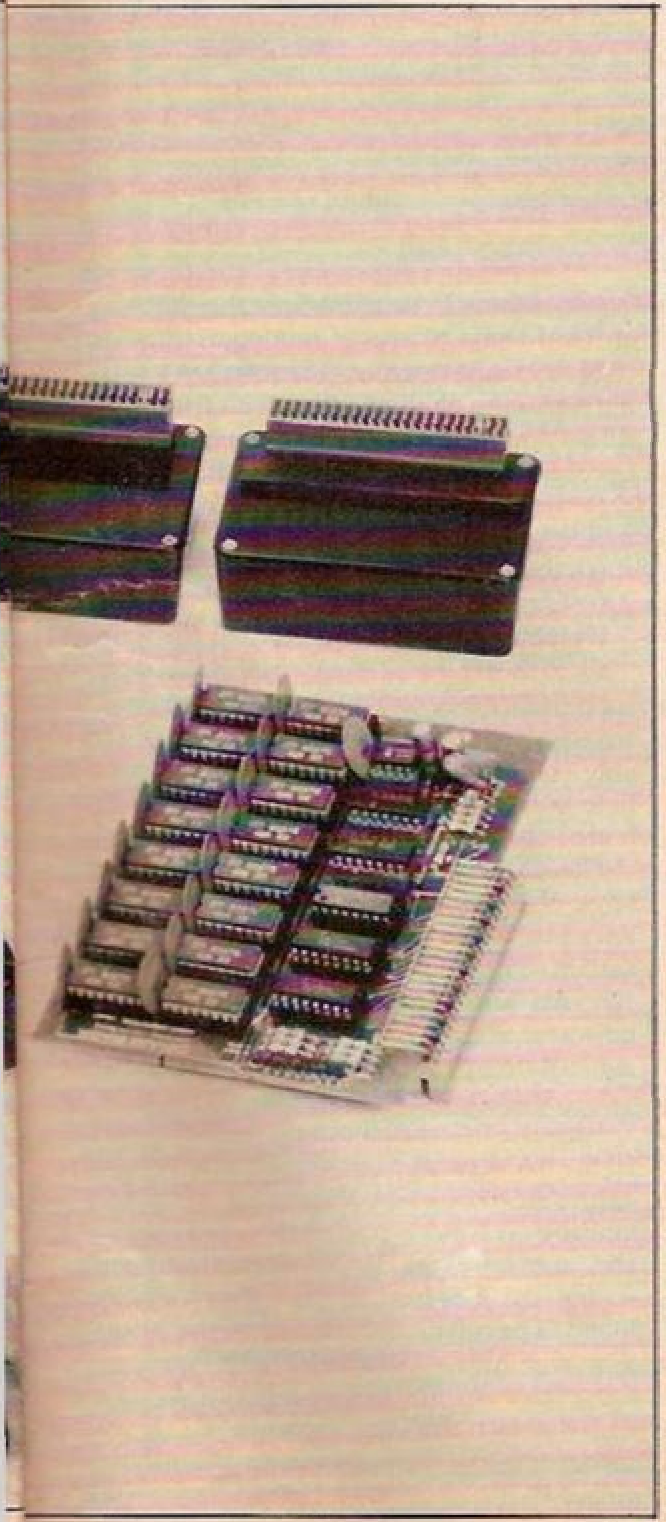


number of turns around the transformer. That should raise the voltage of the transformer to 11V. I do not think it should be attempted by anyone who is not building the RAM pack as a kit. Instead, I replaced the Sinclair power pack with a proper +12V unregulated supply which was home-made and which worked well enough after the RAM had been secured as explained.

It took, however, a good deal of pulling the power plug in and out to reset the RAM pack. A +12V power supply is available to power the RAM pack from Audio Computers, but unless you intend to install it in a case, the mains connections are exposed which could be dangerous.

The +12V supply, if used to power the ZX-81, could cause the +5V regulator to overheat. Therefore, the manufacturer provides a link so that an external power supply can run just the RAM pack.

PACKS

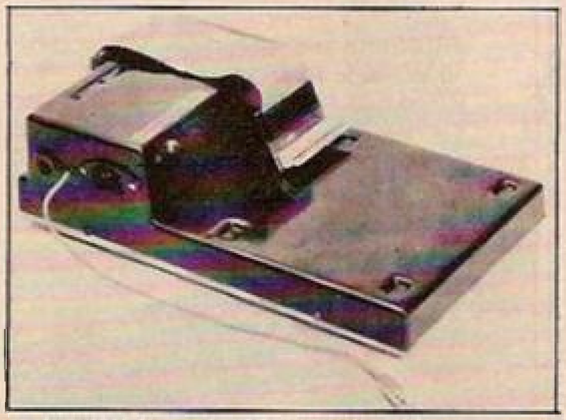


Quicksilva, Memotech and the Audio Computers are the only ones to use sockets for the integrated circuits, which means that the boards can be easily checked and faulty components changed quickly.

All the dynamic memory chips used in the 16K, 32K and 48K packs are industry standard 4116s. These are 16K by one-bit chips and you need eight of them to give the eight-bit byte required by the ZX-81's Z-80A microprocessor. They also required a special signal called REFSH given out by the ZX-81. This tells the RAM when to refresh its memory by reading from one bit and writing it back into the same location.

This must be done in a cycle, so that every memory is refreshed before the capacitors which hold the memory bits discharge. If this is not done, the memory bits are corrupted. This cycle is 2ms. long and 16K of addresses must be covered in this time. Therefore, if any interruption is made to this process, the data stored is corrupted.

The static RAM chips used on the 4K RAM boards are the standard 2114 chips used in some ZX-81s. They need no refresh signal since the bits are stored in a latch which holds them until the power is removed from the chip. Then the data is left scrambled. Only four bits are stored for each memory location, so two chips are required for each 1Kbyte of data to be stored.



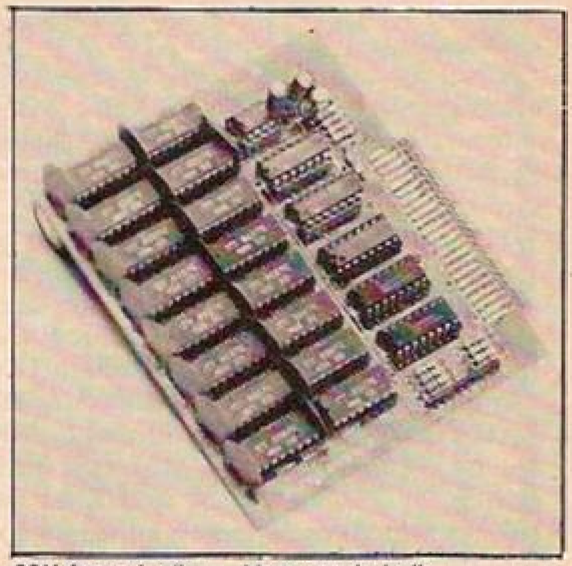
A full 48K from the Memotech pack.

The main reason for using dynamic memory is that it can store 16K in just eight chips — static memory would need 32. Dynamic thus saves both power and space. The type of chip used on the Audio Computers 128K board is a new design which can store 64K by one bit. They take even less power than the 16K version.

The amount of memory which can be stored depends on the amount of space the microprocessor can address directly. Because the ZX-81 uses a Z-80A, which has 16 address lines, A0 to A15, the maximum amount of memory which can be addressed is 64Kbytes. This is the maximum number when all address bits are binary 1.

To decode these address lines correctly, the logic circuitry between the address lines and the actual memory chips must operate the memory chips only when the correct address appears on all 16 address lines. Since the minimum 1K chip will handle the address lines A0 to A9 inside the chip, we need decode only the address lines A15 to A10 externally to operate the chip-select pin CS.

Sinclair Research, however, decided to reduce the amount of logic gates required to decode this memory by dividing the memory map into four sections. This meant that each could be decoded by using only the address lines A15 and A14. This is why the maximum RAM available according to Sinclair was 16K — 64K ÷ 4 = 16K.



32K from Audio — kit or ready-built.

All the RAM was supposed to be turned on only when A14 was binary 1; the ROM containing the Sinclair 8K Basic was turned on only when A14 was binary 0 and the display was turned on only when A15 was binary 1. This meant that the 1K internal memory was appearing 16 times in the 16K memory map as any address in that section operated the CS of the 1K chip.

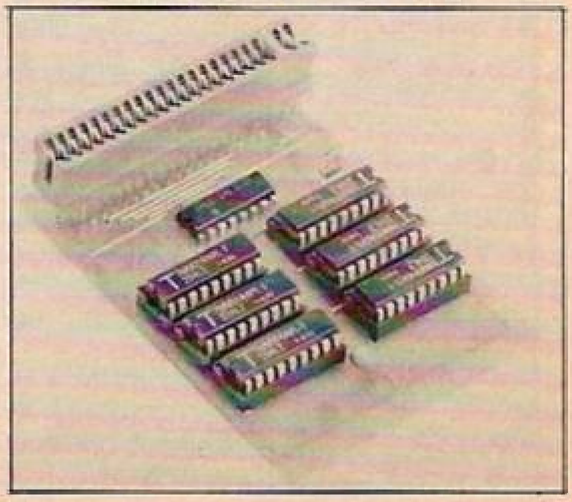
When the 16K pack was introduced this had 16K of memory inside it, properly decoded into its correct 1K sections. So the internal 1K RAM is permanently disconnected by the 16K RAM pack so that it does not interfere. This is done by the RAM CS line on the expansion port.

This inexpensive method of decoding the RAM and ROM also leads to problems if you want to install more memory. For instance, the ROM not only appears at 0 to 8K on the memory map but also any time A14 is binary 0. Therefore, it appears at 8K to 16K, 32K to 40K, and 40K to 48K as well. The 16K of Sinclair RAM also appears at 48K to 64K and this is used to advantage in the programming of the ROM for the screen display.

That is, however, a disadvantage if you want to install more memory in this space as the 48K to 64K is necessary to display the screen and cannot be used. Help is at hand in the form of the ROM CS line on pin 23B of the expansion connector. By connecting this pin to binary 0 at the correct time, the ROM can be turned off completely from the memory

(continued on next page)

Quicksilva uses the 1K of internal RAM.



(continued from previous page)

map and extra RAM inserted. This is one of the reasons that these packs for over 16K cannot be used on the ZX-80 8K ROM without internal modification. The ZX-80 has no ROM CS line on pin 23B as it was not used.

The ROM, when setting Basic, expects to see all the RAM starting at 16K on the memory map, so no extra Basic memory may be used below 16K. The normal 16K RAM pack is addressed then into the 16K to 32K part of the map. The Audio Computers 32K RAM pack extends the Basic memory to 48K on the memory map; the Memotech pack extends, by a cunning trick, to 64K on the memory map. As usual, there is a disadvantage with these larger memory packs.

Add-on requirements

The first 16K must contain any machine code to run from Basic. It must also contain the display file. Furthermore, since the display file sits on top of the program, the program and display file must not leave the lower 16K or the program crashes without warning.

Since the RAMtop is altered to show Basic that there is extra memory available, nothing can be stored above RAMtop. The extra 16K and 32K provided over and above the normal 16K must, therefore, be used only for storing variables and stacks. Yet machine-code routines could be transferred for running into the lower 16K from the variables section. This would have to overwrite a previous machine-code routine in order not to disrupt the Basic listing.

Certain add-on boards use the 32K to 48K region for ports, sound, new character set. So when buying one, remember that you cannot have two devices using the same memory location. The 128K RAM extension, using the new 64K chips, is divided up into 32K sections and only one can be used at a time. They are presented with manual switches which select the 32K section you want to use. The 32K section, after a manual switch, must be set up by using a reset button. This means that the memory has to be cleared of any program before use.

Audio Computers suggests using an input/output port to switch these sections or banks of memory.

The program to run this would have to be situated in the 8K space above the ROM because it must be immune from the switching of RAM banks. A special routine would have to be written in machine code to do the switching and cope with the transfer of variables between programs in different banks. It would be complicated to write and would require both hardware and software knowledge to write. Audio Computers is offering prizes for applications using the 128K pack on the ZX-81.

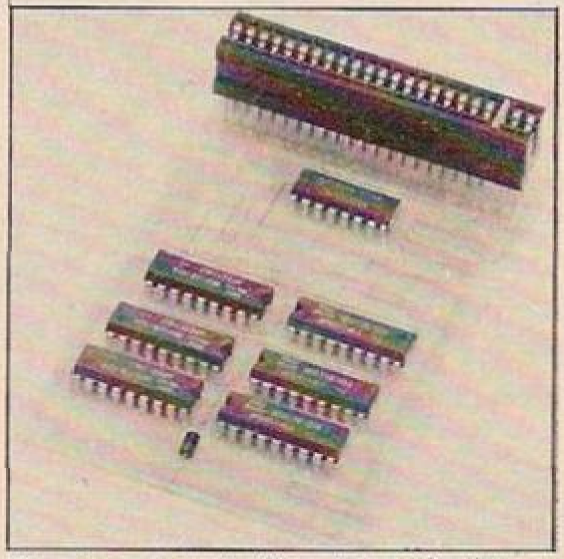
We performed a soak test on all the units. This consisted of 12 hours continuous operation with a memory check program to detect any corruption of the bits in memory. The only one to be affected by this long running time was the Memotech 48K which overheated the ZX-81 and corrupted the data.

The ZX-81 sits on top of the Memotech and some of the heat from the RAM underneath rises, just where the regulator for the ZX-81 is housed. The regulator is already relatively hot and this just pushes the temperature to an unworkable level. If separated by an insulated material from the ZX-81, the problem does not occur.

Adequate instructions were included with all the RAM packs, most of them consisting of a Poke 16389,X where X is the size of memory available. A New then starts the ZX-81 testing and searching the RAM from this point, setting the RAMtop at the highest location found. The two kit instructions for the Memotech and Audio Computers were excellent, apart from Audio's lack of a circuit diagram, and the fact that the capacitor C1 is not mentioned anywhere except on the printed-circuit board. ■

Company	Capacity	Price
Quicksilva, 95 Upper Brownhill Road, Southampton, Hampshire. Tel: 0703-771248	4K	£18
Memotech Ltd, 103 Walton Street, Oxford.	48K	£148.35 assembled £125.35 kit 15 percent educational discount.
Sinclair Research, Freepost 7, Cambridge CB2 1YY.	16K	£52.90
Audio Computers, 87 Bournemouth Park Road, Southend. Tel: 0702-613081	32K — with 16K of RAM — with 32K of RAM 128K	£37.95 £51.75 £141.45
Ceedata, Lead House, Arnfield Close, West Molesey Trading Estate, East Molesey. Tel: 01-941 4889	3K	£16
Hilderbay Ltd., 8-10 Parkway, Regents Park, London NW1 7AA. Tel: 01-465 1059	16K	£42
JRS Software, 19 Wayside Avenue, Worthing, Sussex BN13 3JU. Tel: Worthing 65691 (evenings)	16K	£35

All prices include postage and VAT.



The extremely stable 4K pack from Ceedata.

CONCLUSIONS

- The two 4K static RAM packs from Quicksilva and Ceedata are 3.5in. by 2.5in. printed-circuit boards which use the 1K of internal RAM as part of the unit. They are well made and extremely stable. Their memory capacity cannot be augmented.
- The 16K RAM packs from JRS and Hilderbay are supplied in neat black boxes, 2in. by 3in. by 1.5in. They are as stable as the static RAM, but the cost per K is lower.
- The Sinclair is now much more expensive than the other two 15K RAM packs and is not as neat. It also emits an annoying buzzing sound from its 3.5in. by 3.5in. by 2in. case.
- The 32K RAM from Audio Computers is available in kit or ready-assembled form, but requires an extra +12V power supply. It has a very good amount of detail, but its edge connector detracts from any good qualities it might have. The 128K RAM pack by the same company has problems as only 32K can be used at one time.
- The Memotech pack gives a full 48K of Basic memory — with certain restrictions. It will be useful for large databases as long as precautions are taken about overheating during long periods of use. There is also a 15 percent educational discount available.

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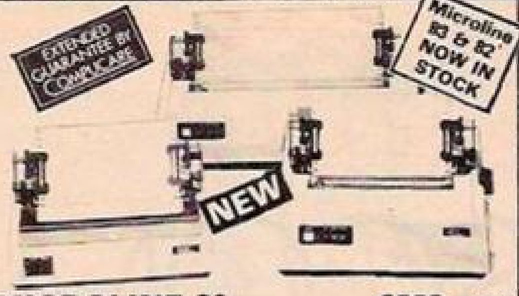


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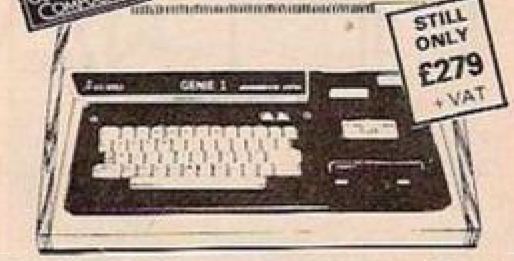
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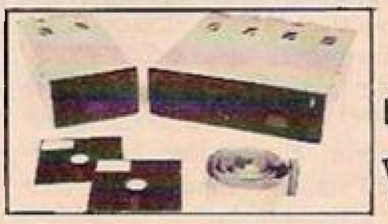


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REVIEW

THE NASCOM RANGE

The Nascom family includes not only the well-known models 1 and 2 but also a host of peripherals and software. Malcolm Bell evaluates the range.

THE ORIGINAL Nascom 1 system has had a facelift and is still alive and looking good, although for most domestic and development purposes it has been superseded by the Nascom 2. At a kit price of £125 plus VAT, the Nascom 1 is very good value for money — it offers a full ASCII keyboard of excellent quality, UHF/monitor output in 16 lines by 48 character format, and serial output port for mass storage of programs and/or data via cassette or printer.

It is a single-board design based around the successful Zilog Z-80 CPU and operates at 2MHz. On board it supports the NasSys 2K monitor and 1K memory-mapped VDU RAM. An empty socket is provided for a 16-bit programmable input/output port. The system is fully expandable up to 64K memory if a buffer board is used. All manner of peripherals can be connected either to the dedicated ports or the 77-way bus.

Flexibility first

The 900 bytes of user RAM provided is only really adequate for learning purposes or applications such as burglar alarms, control, robotics etc., so expansion is eventually necessary. With the expansion boards, the system will support all the software available.

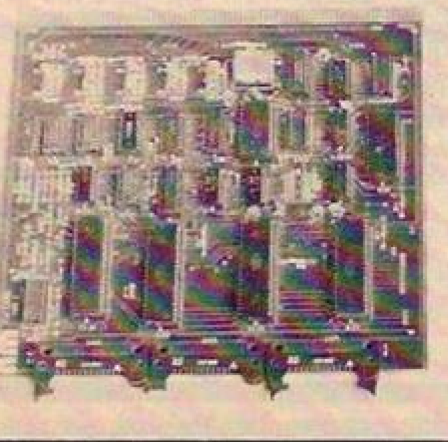
The Nascom 2 is now the mainstay of the range and follows the practices already established by the Nascom 1. Again it is a single-board system but upgraded to use the faster 4MHz Z-80A CPU. Designed with the fullest flexibility in mind, the system can communicate with all standard input/output configurations.

A kit version is available for £225 plus VAT but is strictly for the advanced constructor. A ready-built version costs £265 plus VAT. Both versions are supplied with the 2K NasSys monitor and 8K Basic in ROM as standard, and provision is made on-board for a further 8K of static RAM or EPROM which can be located at any of the 4K address boundaries.

A socket also exists for a 128-character graphics ROM. A 16-bit programmable input/output port is supplied as standard in the on-board socket and additional ports can be added on the PI/O board. Again, the VDU is fully supported, and the cassette tape and printer interfaces are provided.



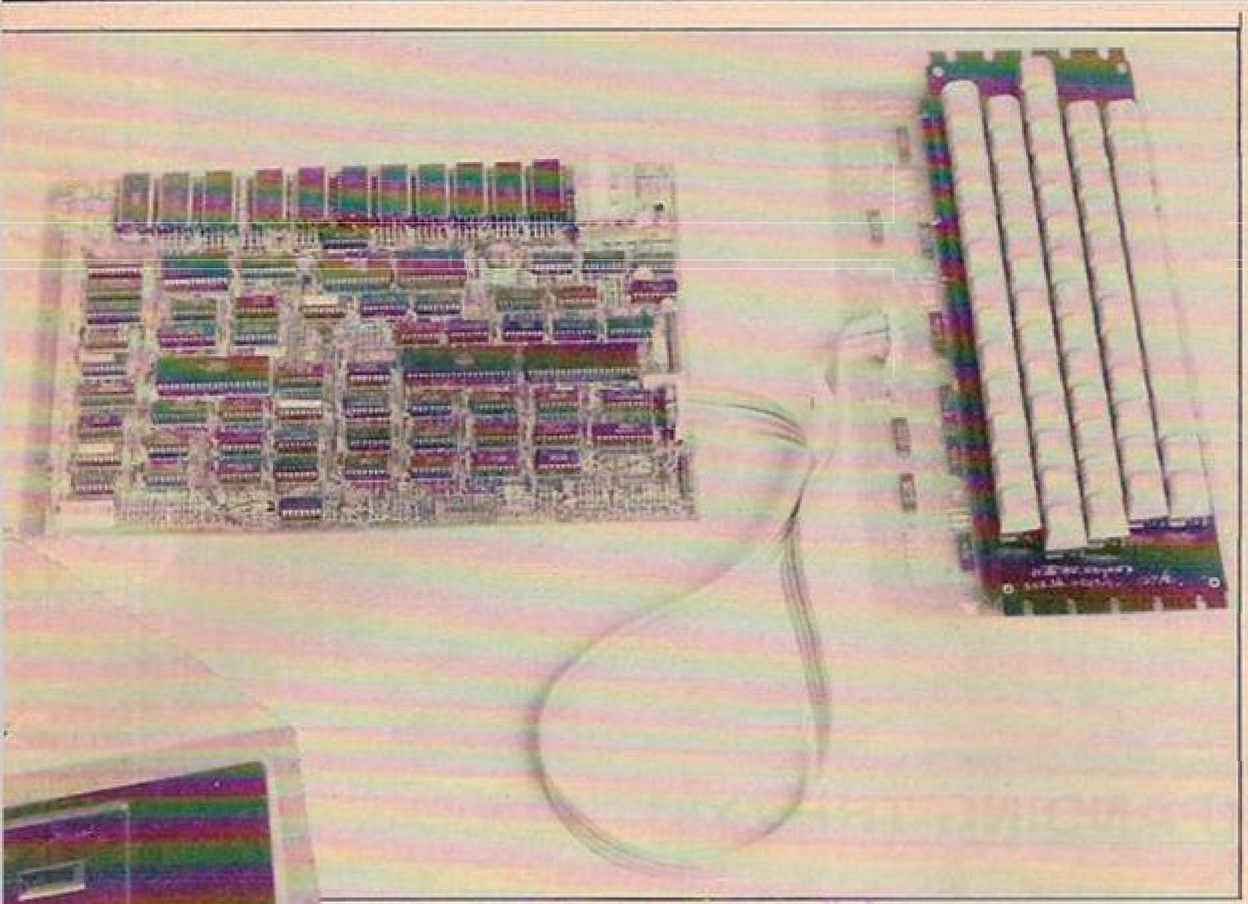
The original Nascom, below, was superseded in late 1979 by the launch of the Nascom 2, top right. Last year, under new management, the model 3, an enhanced Nascom 2, hit the market.

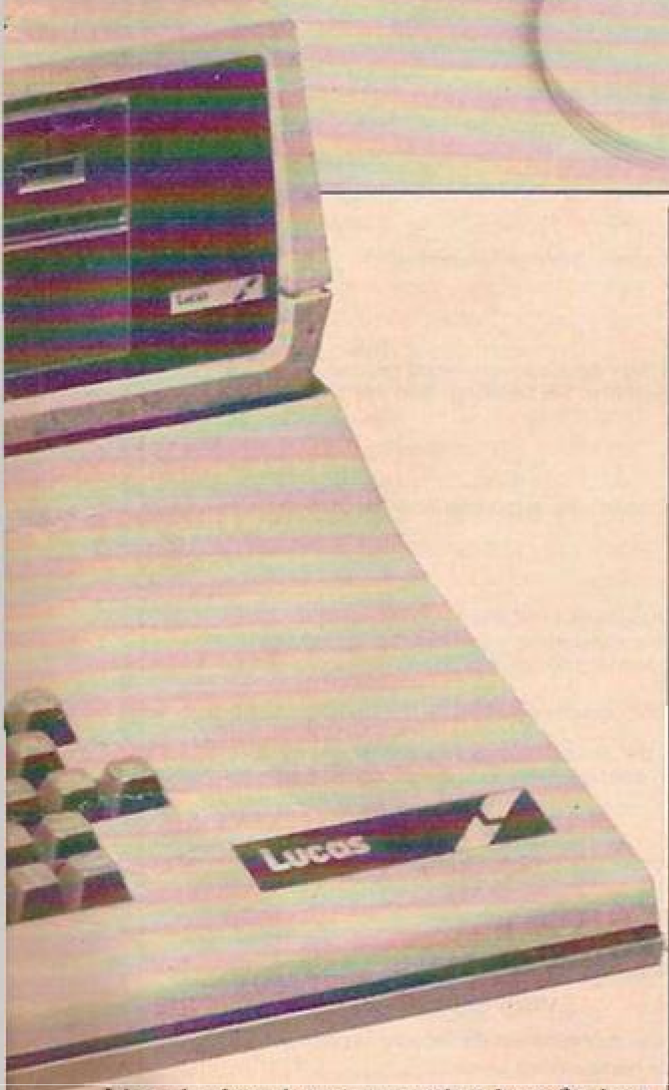




The display is 16 lines by 48 characters as for the Nascom 1 — this is probably the biggest factor in Nascom's lack of success in the business-machine market. The quality of the display on a standard TV set is acceptable although a slight wobble is experienced from time to time on some systems.

The 77-way bus is fully buffered and expansion is facilitated by the add-on boards. The





Licon keyboard uses contactless keys for long life and they are less easily damaged by the heavy-handed user or children.

In all, this system still represents good value for money and can be expanded into a full-size and powerful computer as your finances permit. There are, as always, a few operational problems but they are mostly confined to the software and are gradually being solved. The board and components have proved, however, to be robust and reliable.

More than adequate

The documentation for building and operating the system is comprehensive and includes extracts from the manufacturer's handbooks for both software and hardware.

The power board provides +12V, -12V, +5V and -5V rails. The +5V rail is rated at 3A which is more than adequate for the main board and up to four additional boards, but leaves little spare to power peripherals. As a kit, it costs £32.50 plus VAT and is simple to build. It has proved reliable although it generates a considerable amount of heat. Neither system includes the power board in its price so this is another initial expense.

The RAM expansion board has been upgraded and is now known as Series B. It can accommodate 48K of dynamic RAM running at the full 4MHz and is completely buffered. As an optional extra, the board can be equipped for page-mode operation allowing addressable memory in excess of 64K. The board can be bought with 16K memory for £80 plus VAT, and further memory added for £15 plus VAT per 16K.

The I/O board is essential if the system is to communicate to any great extent with real-time peripherals. It can accommodate up to six eight-bit parallel ports, one serial port, and a counter/timer unit. For the £45 plus VAT you are only buying the board and the support circuitry — the main devices are extra.

Nascom does not market a system case, although the Kenilworth Case is approved. The company does, however, sell a frame manufactured for its machines by Vero and costing £25 plus VAT. It satisfies the need for a permanent housing for the boards but is rather large and not very attractive.

The Imp printer was one of the first of the small printers to reach the market and it represented excellent value. Yet since this market has changed so rapidly, the Imp is no longer to the fore.

The NasSys 1 monitor is a very powerful program supplied in a 2K ROM to be located at memory address 0H. It is now provided as standard on Nascom 1 and 2 so software for either system is now compatible. The program has been constructed to provide the necessary support for the usual input/output formats, has a very comprehensive program editing and debugging section while at the same time makes its own internal subroutines available for use by the user programs.

Background
Since the inception of the Nascom range of systems in 1977, the fame and fortunes of the controlling company have been volatile. When launched on November 27, 1977 the Nascom 1 was hailed as years ahead of its rivals, and so it was — or at least should have been. In reality, it had not been developed to its full capabilities and did not appear on the market for some time. The demand was aggressively stimulated and the 1,000 systems per year figure grew to 15,000.

The launch of the Nascom 2 system was intended to overcome the problems but a world shortage of 1K static RAM packages only frustrated the company still further. The inevitable cash-flow problems worsened, and eventually the receiver was called in.

Following a long period of uncertainty, Alteck Ltd made a takeover bid which eventually fell through. Now Lucas Logic has given the Nascom range a new lease of life.

What has emerged from this turbulent history is both the success and the popularity of the systems, which have managed to maintain their sale figures throughout. Credit for this must go to the designers of the system and the main suppliers.

The eight restarts are used for reset, character input, relative call, subroutine call of internal subroutines, break-point, string output, character output and delay. You can also modify the main keyboard table and system defaults to make the operating system more flexible.

This monitor has been in use now for several years and has proved very successful. Again, the documentation is of an acceptable standard — the biggest advantage is the inclusion of the full assembly listing. This is both informative and instructive. A full list of monitor commands is given in table 1.

Compatible monitors

The NasSys 3 monitor is an upgraded version of the NasSys 1. Two known bugs which were present on the NasSys 1 have been removed and several interesting new facilities are included. It will eventually become the standard, but at £25 I question whether the extra facilities warrant the expense of changing. The NasSys 3 is downwards-compatible with the NasSys 1 with the exception that the paper tape input command, L, has been dispensed with.

There are three new commands P, D and Y for displaying the user-program registers, execution from 0D000H, and execution from 0B000H respectively. In addition, the Tabulate command has been improved to display hexadecimal and ASCII values, the External command, X, has additional options, and the input command, Read, now has the option of reading with an offset value. An additional feature gives keyboard repeat with adjustable blink rate of the cursor.

The Nascom Basic is provided as standard on the Nascom 2 in ROM and can be purchased separately in ROM or on tape for the Nascom 1. It is an 8K package and a derivative of the widely-used Microsoft Basic, but because it makes extensive use of the internal subroutines of the NasSys monitor, it is comparable with most 12K Basics. Table 2 shows

(continued on page 23)

(continued from page 21)
the complement of Basic commands. Most worthy of note is the absence of Save and Load commands for string arrays, making file and data handling more time-consuming than normal. There are useful display-manipulation commands and graphic features — Set, Point, and Reset.

The speed of operation of the Basic when used in the Nascom 2 at 4MHz is very impressive — it is twice as fast as the Commodore Pet.

The Zeap Z-80 editor/assembler program is available in EPROM or cassette tape packages — £37 or £25 respectively. It is vital if any program is to be written directly for machine code. It contains an editor to facilitate the entry of programs in the assembler mnemonics of the Z-80 CPU and then translates that listing into machine code.

Crude but useful

The code can be generated directly in memory or can be output to cassette for subsequent reloading. With Zeap, error correction and program modification are greatly simplified, and it includes such features as multiple line deletions, automatic line entry and renumbering. The tape version has a primitive yet useful facility for checking that the assembler program has not been corrupted while the user program was running. For the full benefits you should use Zeap in conjunction with a printer.

The NasDis is the complement of Zeap. It will read the object code of a program and display or print a listing showing the code, the mnemonic, labels all jump-entry points and provides a cross-reference list. Like all disassemblers, it cannot distinguish between program and data, but this does not usually give rise to confusion. The package is supplied in three EPROMs at a cost of £37.50 plus VAT.

The Nas Debug diagnostic package is a 1K package that must be used in conjunction with NasDis. It provides many useful extra features such as the direct register access used in the NasSys 3, dual page mode and direct editing of the assembler listing as the program is stepped through. It is a useful addition at only £15 plus VAT.

Table 2. Nascom Basic.

		Commands		
NEW	LIST	CONT	MONITOR	RUN
CLEAR	NULL		LINES	WIDTH
		Statements		
DEF	DIM	REM	WAIT	END
POKE	DOKE	DEEK	PEEK	STOP
IF..THEN	IF..GOTO	ON..GOTO	ON..GOSUB	GOTO
SET	RESET	GOSUB	RETURN	FOR
POINT	LET	USR	TAB	SPC
		NEXT		
		Input/Output		
PRINT	DATA	INPUT	READ	CLS
INP	OUT	SCREEN	RESTORE	
		Operators		
=	–	+	×	
<>	<	>	=<,<=	=>>=
NOT	AND	OR		
		Arithmetic functions		
ABS	ATN	LOG	SIN	INT
SGN	TAN	COS	POS	RND
	SQR	EXP	FRE	
		String functions		
ASC	CHR$	STR$	RIGHT$	LEFT$
LEN	MID$	VAL		
		Cassette input/output functions		
CSAVE	CLOAD	CLOAD?		
	CSAVE*	CLOAD*		

Table 1.

A	xxxx yyyy	Arithmetic in hexadecimal
B	xxxx	Break-point set
C	xxxx yyyy zzzz	Copy — move data
E	xxxx	Execute
G	xxxx yyyy zzzz	Generate — write a program to tape including an execution address
H		Half-duplex terminal
I	xxxx yyyy zzzz	Intelligent copy — moves data with overlap protection
J		Basic cold start
K	xx	Set keyboard options
L		Load from paper tape
M	xxxx	Modify data
N		Return to normal I/O
O	xx yy	Output data to a port
Q	xx	Input data from a port
R		Read from a cassette
S	xxx	Single-step through program displaying register status
T	xxxx yyyy zzzz	Tabulate data or write to paper tape
U		User-specified I/O routines
V		Verify data written to cassette
W	xxxx yyyy	Write data to a cassette
X	xx	External serial device control
Z		Basic warm start

Word processing is a complicated field and the operating programs are usually very large. So, when considering the Naspen word processor, its size of just 2K must be taken into account. There is no doubt that the facilities it offers are of great value when documenting software, and can be used successfully for letters. However, the commands offered correspond more closely to those found on an editor than on a word processor. Pagination is catered for and page-width or page-length settings can be adjusted, although Naspen does not actually form the text into pages. It is, nevertheless, a useful and recommended program worth every penny of its £30 price.

The Kenilworth case is made from hardwood and steel and is designed for the Nascom 2. It accommodates the main system, power supply and keyboard. By adding support kits, up to five additional expansion boards can be included, which should be adequate for the needs of most users. It is reasonably pleasing in appearance although not up to professional users' standards. The TV or monitor can stand on the case's upper surface and all external connections are made at the rear. Priced at £49.50 for the basic unit and a further £7.50 for the two-board expansion, it is not cheap but does make a compact and practical unit.

The design of both systems leaves the cassette-input and the keyboard port open for all system input conditions. This can give rise to spurious characters from the tape or error entries. The £17.50 Castle Interface provides a more sophisticated tape-handling mechanism, motor control and printer/cassette switching. While not in any way essential, it provides a useful function.

Different versions of the program exist for the two monitors but the functions offered are identical. Both are priced the same at £28 for two EPROMs. Their main use is for entering and editing Basic programs, but they can be used for the main system control if the system reset address is set to its start location.

The functions provided are as follows:

APPEND	Add other basic programs
AUTO LINE NUMBERING	with initial and step variables
DELETE	Single line or block delete
DUMP	Prints to screen all user variables but not arrays
FIND	Finds and displays a specified string
HELP	Displays for modification a specified line — with compression if required
HEX	Hexadecimal to decimal conversion
INKEY	Input from keyboard
RINK	Input from keyboard
MONITOR	Passes control to NasSys
RENUM	with initial and step as variables
STEP	Single-step through a program displaying requested variables

It is a very powerful aid and is strongly recommended.

The Henry's Radio Basic Programmers' Aid is supplied only on tape at £13 and combines some of the features mentioned with the addition of cross-referencing. Screenplus is marketed at £40 and connects to one of the eight-bit ports to produce an enhanced VDU display with reverse-video options for character, word or screen blocks in addition to screen blanking. For that price the user must want those facilities very badly.

The Sargon chess pack costs £35 and includes a manual, chess-graphics board with dedicated ROM and the program on cassette. The documentation for the soundbox programmable sound generator suggests that music can be programmed in Basic into this unit where it is fed to a three-sound channel, dedicated music chip. Then it is passed to the on-board power amplifier and 3in. loudspeaker, or home stereo. It is good value at £39.50. The Arfon speech board is for the man who wants everything. This speech board uses Digitalker and can be connected to the Nascom for £85.

There is a wide range of non-approved products — the most notable being the Gemini 5.25in. double-sided, single-density floppy-disc unit sold by the suppliers for about £450.

CONCLUSIONS

- Despite its chequered career, the Nascom range still has much to offer and its price is compatible with its main competitors.
- A dual-drive, double-density, double-sided, floppy-disc unit with NasSys-compatible control is to be introduced.
- CP/M will also be available.
- For the business market, an advanced video card is to be released which will give 24 lines of 80 columns, high-resolution graphics and colour. It will cost about £120. ■



BEHIND THE

Producer Paul Kriwaczek is the man in charge of bringing microcomputing to our TV screens. Brendon Gore visited him at the BBC studios, and together they delved behind the scenes of *The Computer Programme* to examine the original series concepts and how those ideas were put into effect.

PAUL KRIWACZEK HAS the distinction of being the only practising dentist to run a night-club in Kabul, Afghanistan's capital — a fact which should lead you to conclude that he has had a very varied career for a television producer. Born in Vienna, he arrived in England at an early age and was educated at Kilburn Grammar School and Queen Mary College, University of London. He qualified as a dentist at the London Hospital medical college and practised for six years in various parts of England, Afghanistan and Africa.

As for his stint as night-club proprietor, he says: "I was travelling with a friend who was a superb pianist — I played alto sax and flute — and we met two Americans, a base player/singer and a drummer. We formed a group and won sponsorship from the U.S. Information Service. There was no night-club in Kabul at the time, so we set one up at the Khyber restaurant with our group providing the music". It was, says Paul Kriwaczek, tremendous fun.

After leaving Afghanistan, he returned to England briefly and then went to Africa to practise dentistry as a locum. However, for various personal reasons, Paul Kriwaczek decided it was about time he changed his profession. In 1968 he joined the BBC as a script writer for the overseas radio service in Bush House.

He gained experience as a radio producer, and started working in the television science features department. Finally, he moved to the continuing education in televison department where he became involved with *The Computer Programme*.

"*The Computer Programme* series originated about four years ago with the realisation that the microelectronics field was a very important one and that we, as an educational department, really ought to be taking a major lead", says Kriwaczek. "The end result was the rapid production of four or five programmes called *The Silicon Factor* which was an interim holding effort, as it were, looking in general at developments in microelectronics.

"David Allen, who produced *The Silicon Factor* and rapidly became the department's microelectronics expert, then made another series called *Managing the Micro* which was specifically intended for managers.

"But between the original decision to become involved in microelectronics and the end of making *Managing the Micro*, there had been a revolution in the price of personal computers. Given the availability of the microcomputer, it seemed appropriate to start a series which aimed at a wider audience".

Paul Kriwaczek was asked to produce a new series which was to explain computers to the layman. He spent a year learning everything he could about computers, even to the extent of buying and programming a Nascom 2. This research not only turned Kriwaczek into a microcomputer enthusiast, it also convinced him that if the project were to be attempted at all, it had to be more than just another television series.

The BBC Microcomputer is a separate operation to *The Computer Programme* — a fact stressed by Paul Kriwaczek — but the one necessitated the other. It was almost impossible for the BBC not to become involved in marketing hardware once it had decided to become a major software publisher, explains Kriwaczek. "At the very beginning, all our advisors told us it was absolutely necessary that an organisation with the standing and public confidence of the BBC should enter the business of computer software, but software for what"?

Kriwaczek admits that the BBC Microcomputer is not a cheap machine: "But then a colour television is not cheap either, nor is a stereo system, and we are talking about commensurate kinds of prices. I would have been very reluctant for the BBC to sell something like the Sinclair because it is so limited. The Sinclair cannot be expanded; it is fundamentally a throw-away consumer product. Its usefulness is in learning about programming, but I do not believe that the future of computers lies in everyone learning to program in Basic.

"The BBC Microcomputer is expensive, but it's still the best value for money on the market. It has graphics which no other microcomputer possesses, and it has a Basic which gives you as much flexibility as you could want from the language. A 32-bit processor, which is in the design stage at the moment, will make it possible to expand the BBC Microcomputer into the most powerful business system you could wish for".

The Computer Programme, however, is not designed to sing the praises of any one computer — not even the BBC's. It is more concerned to explain how computers work, the ideas that lie behind them and the applications to which they are being put. *The Computer Programme* is essentially an introduction for the unitiated. "What I hope the programme will do", says Kriwaczek, "is to show people first of all that computing is not difficult to understand; secondly, to alert them to some of the things that are going to be happening to them in their lives as a result; and thirdly, to suggest that the way in which computers work may be a useful way of looking at things".

Yet Kriwaczek's hopes for the programme have been affected by the decision to show it at off-peak viewing times. The first programme in the series was transmitted on BBC2 on Monday, January 11, at 3.05pm. It was repeated on BBC1 on Sunday, February 14 at 10.10am and is due to be shown again on BBC1 on Monday, March 22, at 11.35pm.

"My brief was to produce a popular programme for the layman. That's what I was asked to do — it wasn't my decision. I therefore expected that it would be transmitted at such a time when the layman would be watching. None of the transmission slots that we have at the moment seems to me to satisfy that definition. If I had thought that we would be restricted to what necessarily will be a minority audience, I would probably have made an entirely different series".

The series that Kriwaczek has made was determined not just by its intended audience, but also by the

'TV production is part art and part pure accident'

subject matter and by external circumstances. Kriwaczek was given 10 25-minute programmes for the series. Given that limitation, he had to decide whether to make a sequential series with programme 2 starting where programme 1 ends, or whether to devote each programme to a single idea.

"We know that people do not watch the whole of a series", he says. "We know that only about 50 percent of the people who watch programme 4 of a series will have watched programme 3 and only about 50 percent of those are going to go on and watch programme 5.

BBC PROGRAMMES

You cannot guarantee that your audience will have seen any other programme, so each programme has to stand alone.

"As the subject area you can cover in 25 minutes is limited, and the number of different principles in computing is not actually that great, the best idea is probably to devote each programme to a separate principle or concept. But if the series is just about principles and concepts it will be boring, so you divide the series in half with the first part dealing with fundamental principles and the second part looking at various applications.

"Then you say to yourself, hang on a moment, we ought to make programme 1 a general introduction to the whole area so people know what's going on. If we do that, we should make the last programme a kind of pull-together of all our other ideas about how society is to be affected by this revolution we are seeing around us. So that gets rid of programmes 1 and 10. Programmes 2 to 5 deal with basic principles and programmes 6 to 9 cover applications — and that's how you decide how to do the series. Your decisions are really forced on you".

Choosing presenters for the series was not an easy task. Kriwaczek was looking for three people, a computer expert, a lady reporter and a representative layman. Chris Serle, who had worked for the education department before moving on to *That's Life*, was an obvious choice for the representative layman, but the other two presenters were much harder to find.

'The ZX-81 is a throw-away consumer product'

By chance, David Bellamy, who had been working with Kriwaczek on *Backyard Safari*, suggested contacting Ian McNaught Davis, European head of Comshare. "McNaught Davis came to a meeting in this office", says Kriwaczek, "and I showed him the pilot programme we had already made for the series. He instantly sold himself to us because he was just so obviously very good".

The lady reporter was found simply by seeing a good deal of would-be lady reporters. After lengthy discussions and trying some of them on film, the choice fell to Gill Neville.

Producing any television series, let alone *The Computer Programme*, is a difficult undertaking. Paul Kriwaczek is concerned with all aspects of the programme from film editing to the minutiae of deciding whether or not to have potted plants on the set.

He is also responsible for managing the entire team of directors, presenters and assistant producers and trying to get the best out of them. Television production is part art, part craft, part experience and part pure accident, he concludes.

"You must have a feel for structure and form just as you have with writing anything, because television is a narrative form. When you write an article you are trying to lead people gently from one idea to the next without making them think suddenly 'Hey, how did we arrive here?'

"You are trying to make them read the article without being conscious of having read it. Equally, the art of making a good television programme is to give people something to watch that will interest and entertain them without making them aware of having to sit through it".

A follow-up series to *The Computer Programme* is likely but it is still too early to say what form it will take. "It will probably be a much more particular series about the use of the microcomputer at home", says Kriwaczek. "David Allen will be producing it, but more than that I do not know".

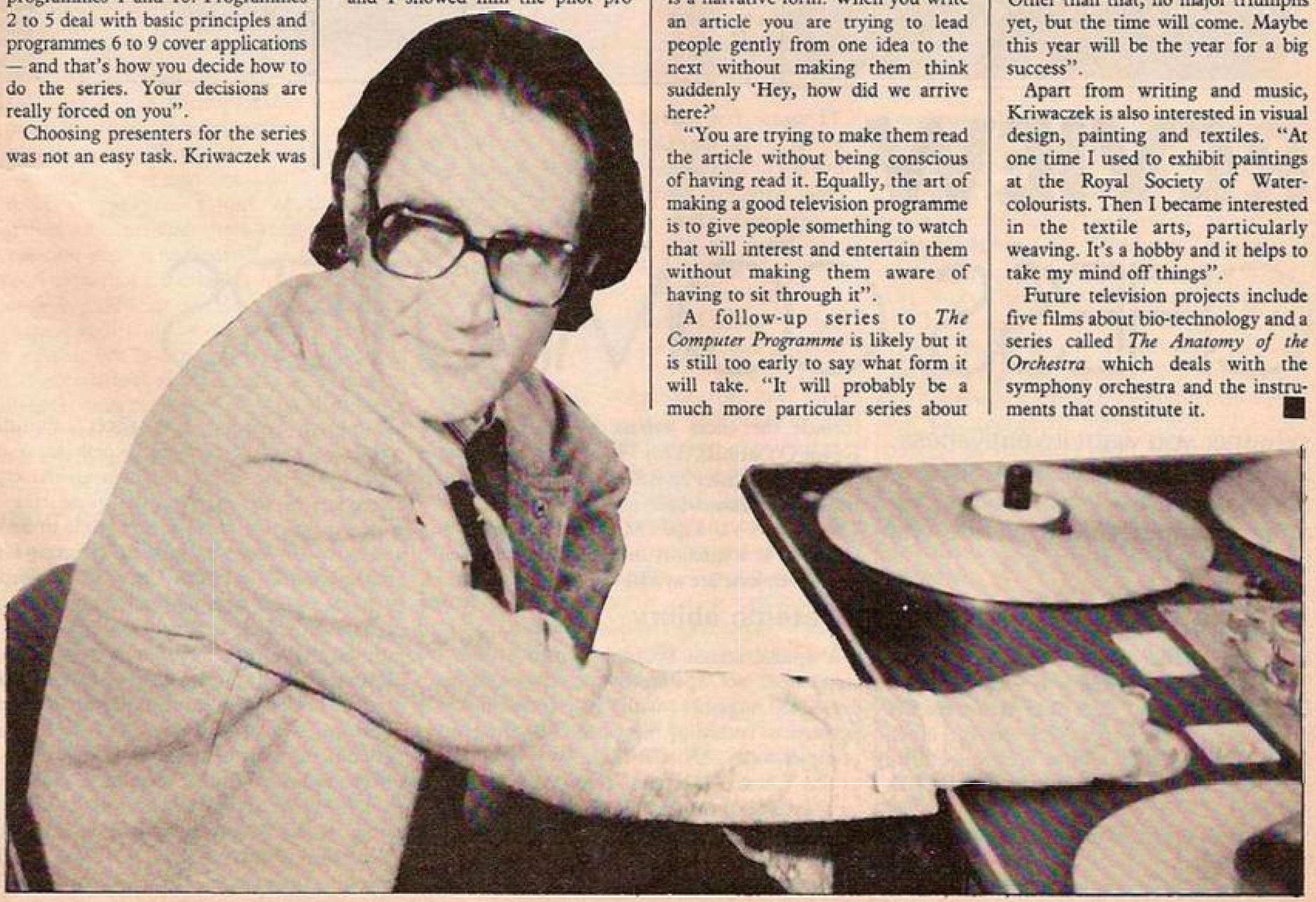
Kriwaczek plans to take a month's holiday in Devon once *The Computer Programme* is completed. Not that he will simply be puting his feet up — he has a few short stories to write and a film script to work on.

"I write a good deal, both for radio and the stage. My biggest success, so far, is the fact that my adaptation of Brecht's *Fears and Miseries of the Third Reich* has been accepted as the standard one which everybody plays. Other than that, no major triumphs yet, but the time will come. Maybe this year will be the year for a big success".

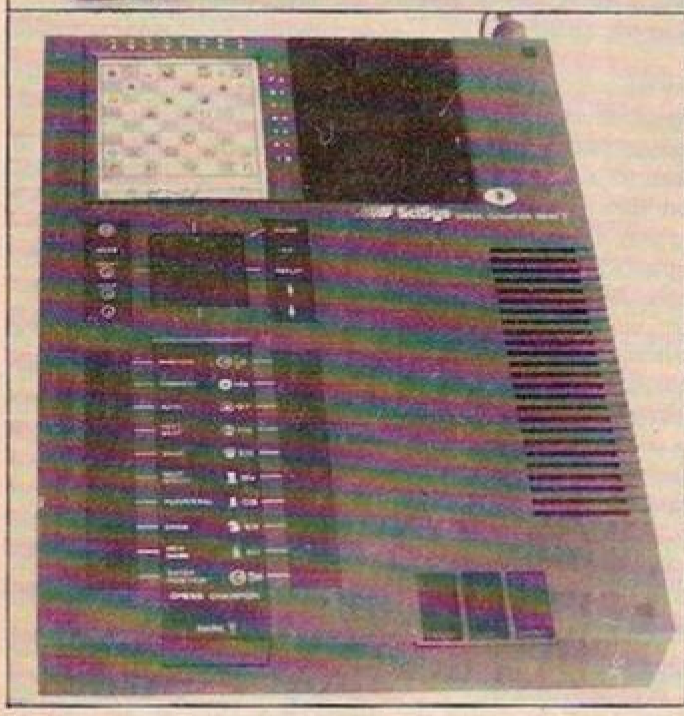
'Computing is not difficult to understand'

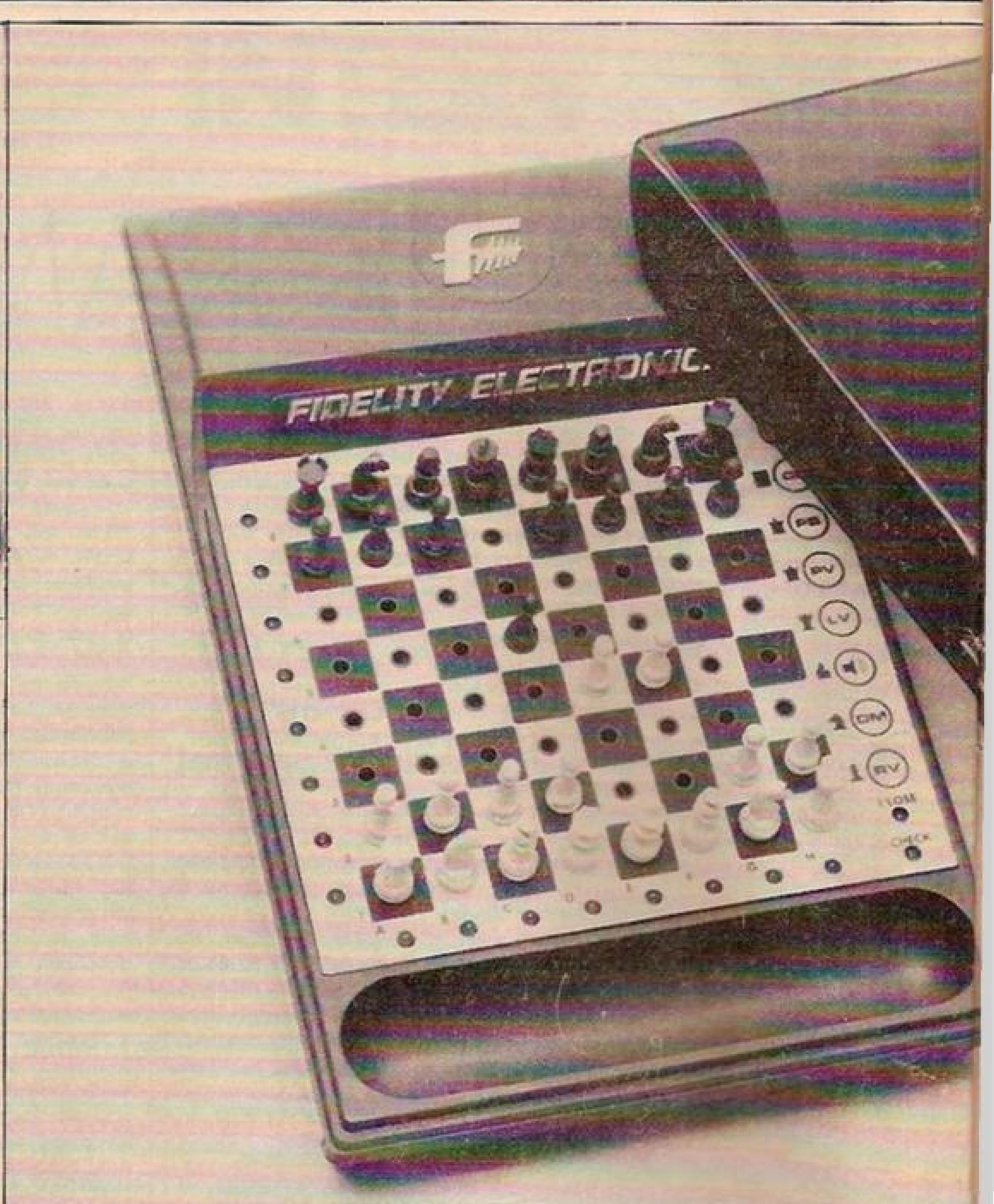
Apart from writing and music, Kriwaczek is also interested in visual design, painting and textiles. "At one time I used to exhibit paintings at the Royal Society of Watercolourists. Then I became interested in the textile arts, particularly weaving. It's a hobby and it helps to take my mind off things".

Future television projects include five films about bio-technology and a series called *The Anatomy of the Orchestra* which deals with the symphony orchestra and the instruments that constitute it. ■









REVIEW

CHESS COMPUTERS

Whether you want inventiveness, strong positional play or sheer tactical virtuosity from your chess machine, John White will help you choose.

THE APPLIED Concepts Sargon and the Challenger programs from Fidelity have always shared a similar style, even before the Spracklen husband-and-wife team joined Fidelity — Dan and Kate Spracklen were the brains behind the Sargon 2.5. On the other hand, different minds have clearly been at work for the Hong Kong-based company Sci-Sys.

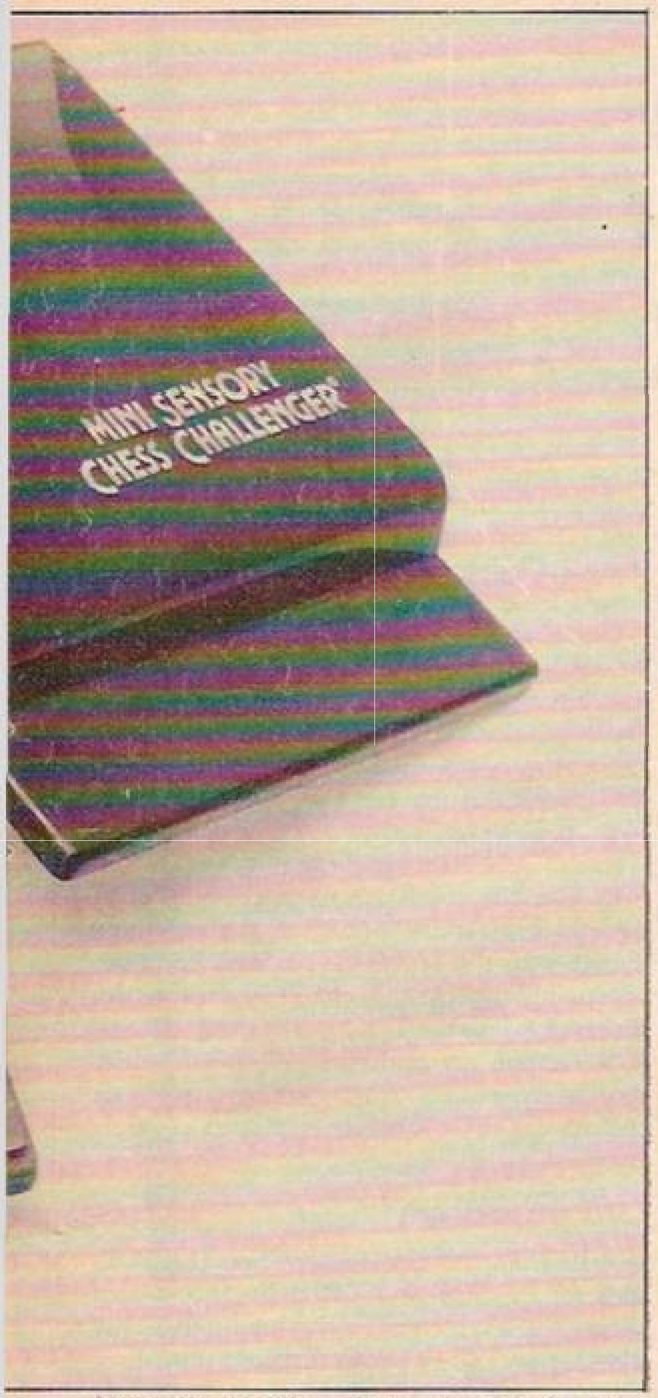
The best program to run in the Sci-Sys Chess Champion V was created by the U.K. software company Philidor whose directors include the chess writers David Levy and Kevin O'Connell. This Philidor program was originally written in Z-80 code, but has been translated into 6502 code for the Chess Champion V. Like Morphy, Philidor is supplied as a module, to be exchanged when better versions are available.

Strategic ability

A special sensor board — which I understand does not operate by touch — will be available, together with a printer for a permanent record of the game. The program occupies some 24K of ROM.

The Chess Champion V recognises draws by stalemate, three-fold repetition or under the 50-move rule. Interestingly, it will also give its assessment of a position and offer or accept a draw accordingly. Unlike Morphy and Champion Sensory Challenger, Philidor claims to have implemented new ideas on move evaluation which result in greater consideration of any part of the game tree — which is what a human player tends to do — and new, still-secret methods of effecting fast, strategic evaluation. The Chess Champion V is claimed to be the first machine of any type capable of making strategic assessments of a position, as opposed to purely tactical considerations. If is, therefore, the first computer capable of forming comparatively long-term plans, the lack of which has plagued all previous commercial models.

Extraordinary claims have been made for the Chess Champion V; that its play exceeds a rating of ELO 1,900 or BCF 163, at an unspecified level. It has also done well against other chess computers — it won the September



1981 World Micro Championship in West Germany in the commercial section.

Chess Champion V plays at as fast a pace as the Sargon or Champion Sensory Challenger — it is unquestionably one of the new generation of super-fast chess computers. In the position shown in figure 1, it found the move a6-c5 within 1.5 minutes — an excellent response in a difficult position. It also retains the tactical ability of the other machines to a large extent, but is not so brilliant at high-speed combinations as the Champion Sensory Challenger, or as capable of tying its opponent into positional knots as Morphy. Automatic moves, where only one move is legal, are made at once.

Cursor confirmation

The Chess Champion V possesses a considerable book-opening library from which the opening is randomly selected. Other facilities include the ability to find mate-in-seven problems, to play up to 12 games at once, to retrace moves, to think during its opponent's time and to give prompts to its opponents.

The entire unit has a very pleasing appearance. Moves can be entered by pressing buttons or by a novel method which involves moving a cursor over pieces visible in a built-in, supplied liquid-crystal display board. This provides constant confirmation that you and the machine are thinking about the same move. However, the design of the pieces leaves much to be desired.

As far as I can tell by testing, the Chess Champion V's strategic evaluation consists of advancing pawn masses, either majorities against minorities or against the castled enemy king, and of moving pieces into lines of attack against this king. Evaluation is performed at considerable speed, and is a creditable achievement. Such planning gives the machine an advantage over its fellow chess computers, and its strategic play makes many games look brilliant.

Play a test game

Like other machines the Chess Champion V likes to sacrifice its knights for enemy bishops early in the game. It is also prone to suffering from doubled pawns. The end-game play is interesting. The pawn masses are advanced with considerable skill but the king is perhaps less active than it should be.

Chess Champion V is the most interesting of the major three chess computers, and plays in a style most like that of a human. Its many user features are well conceived and will have wide appeal. The price of the main unit is £280, and the sensor board will cost some £155.

Those with about £300 to spend should decide whether they want to play against an inventive opponent — Chess Champion V — a positional opponent — Morphy — or a tactical opponent — Champion Sensory Challenger. I should strongly advise you to test your choice before parting with the money.

There are two other very strong chess computers, but neither can be obtained in the U.K. They are the Savant from the Hong Kong-based Novag company, and the Mephisto which has been available in the rest of Europe for some time now without reaching these shores.

The Novag range of Savant and Sensor IV was to have been imported into the U.K. by the importers of Grandstand Leisure products, but the company achieved only limited success with the bottom-of-the-range Novag Microchess, and now the other two may not be imported at all — despite plans for a launch in 1982. The Savant uses the Mychess program, a version of which — rated at ELO 1,615 — is also available for the Apple computer.

Sensory boards eliminate the need for players to key in moves, and three of the major manufacturers have entered the large £50-£100 market with suitable models.

The £55 Sensory Mini Challenger from Fidelity is designed as a travelling companion with pegs for playing pieces, battery operation — AC is an optional extra — and a sensory board. The program is on a replaceable module. Other modules to be released include Advanced Chess, Popular Book Openings and Chess Master Games, as well as checkers and others. The original module includes random selection between moves of equal merit. There are no true book openings, but the machine will give different opening moves.

The Mini Challenger has four levels of play — the fourth is of indefinite duration for problem solving. The third level takes 60 to 100 seconds per move, at which speed the standard of play is surprisingly good for such a low-priced machine. The sensory board also works well. This is an attractive machine, which will demolish most of the others available at this price.

Conceptually similar, Novag's £80 Microchess has a 4K program with seven levels and an eighth, indefinite level which uses iterative deepening. The program is not on a replaceable module. The unit is beautifully built, and the machine also features a memory for storing uncompleted games for up to a week — useful if the train reaches the station too quickly.

Sci-Sys has entered the market with the £80 Sensor Chess, another 4K program with eight levels, a small, randomly-selected book-opening library and a program on a replaceable cartridge. Replacement cartridges include Strong Play, Extra-strong Play and Hypermodern in the chess field.

Sci-Sys has also released Graduate Chess at £35 — a travelling game without a sensory board — and Executive Chess at £90 — a 4K program developed around a large liquid-crystal display device which serves as a pocket

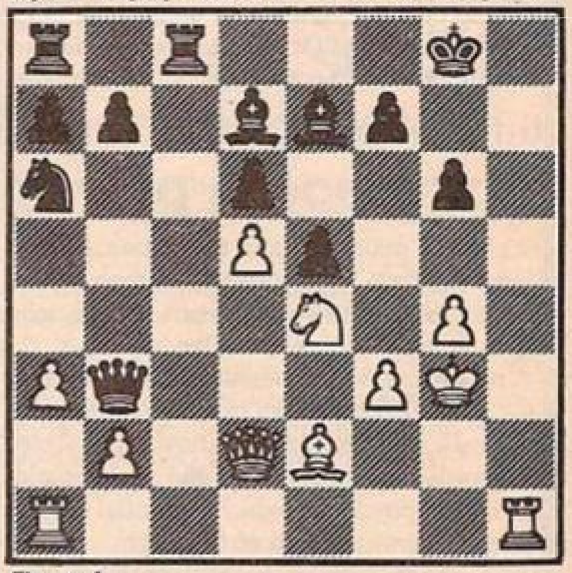


Figure 1.

chess-board. Tandy's £35 Graduate Chess and £50 Chess Machine appear to be replicas of the Sci-Sys Graduate Chess and Chess Traveller; Dixon's Chess Machine also bears a strong resemblance to the Chess Traveller.

The Fidelity £360 Decorator Challenger consists of a slightly-upgraded version of the older Voice Challenger, now in a very decorative housing.

The eight-level Chessmate from Commodore at £60 consists of a stand-alone unit — the user supplies his own chessboard — with touch-sensitive buttons and 32 book openings of 16 moves each. The standard of play is poorer than that of the other newcomers, and on a par with the £60 Boris Diplomat II which replaces the older Diplomat and is designed as a travelling companion.

The £1,500 Boris Handroid contains the Sargon 2.5 program in an amazing device consisting in part of a robot arm, which moves the pieces for you, and a sensory board. Since the improved Morphy program is available in the Encore machine from the same manufacturer at about £180, you will be paying considerably more than £1,000 for the dubious privilege of having a machine make slightly inferior moves, although the Sargon 2.5 is still a very strong program.

(continued on next page)

(continued from previous page)

The £80 Partner 2000 is another Sci-Sys machine with a sensory board but you have to press Enter after making the moves and must read the machine's response from a display. Castling and *en passant* require special attention. This 4K program chooses randomly between a very limited opening library.

Sci-Sys seems determined to flood the lower end of the market with 4K machines, and one must compliment the designers on their achievement in packaging so much into so little. Nevertheless these machines are probably best suited to beginners. In my opinion, Partner 2000 is rather weaker than the older and comparably-priced Chess Challenger 7, although that needs 32K of ROM.

Much better is the new £120 Super System IV, a revised version of the older Super System III. The new model, like the old, has provision for an optional liquid-crystal display board at £75 and a £75 printer, but there is no sensory board. Unlike its predecessor, the System IV has a reasonable book-opening library, 12K of ROM and the program is supplied on an upgradeable module. A very powerful version of Othello, or Reversi, is also available for this machine.

Hi-fi converts

The whole unit, like all the new Sci-Sys range, has a very modern appearance and the price of the main unit and the optional extras is, in each case, significantly less than that of the earlier equivalents. I can recommend Super System IV as good value.

A new name is the Westrak Chess Computer CC1 at £130. This bulky machine is imported by Howland-West, better known for stereo equipment, and has a solid and perhaps old-fashioned appearance which potential buyers will either love or loath at first sight.

The playing pieces each have long jack-plugs protruding to operate the sensory board — a technique which works very well. There are 12 levels in all, of which the first six have response times of between 30 and 60 seconds, and the other six of between nine and 15 minutes. The machine also features plenty of loud beeps.

The CCA possesses no book openings, but the standard of play even at the lowest level is satisfactory — although not as good as the Sensory 8 — and clearly contains some original thinking in the evaluation function. The king does have an unfortunate tendency to wander during the mid-game. Overall, then, it is an unusual and distinctive machine.

A number of new releases have been made in software for personal computers. There are at least three for the Sinclair ZX-80/81 with 16K expansion. Z-Chess and Chessmate 80 have become available for the Tandy TRS-80 and there are several others. Those few which I have seen pay more attention to the quality of their graphics than of the play, and some set a nadir by which to judge all others. At least one employs no look-ahead even at the top level, and kindly formed up all its pieces for my rook to take them.

Software packages

Among four stronger programs held in software, some of which approach the strength of Morphy Champion Sensory Challenger and the Chess Champion V, is Gambiet 80. This program requires 10K for a Tandy TRS-80 and has a good record against other chess computers. It is distributed in the U.K. by MicroTrend. Mychess has a rating of USCF 1,615 — about BCF 127 — and is available for the Apple, but I believe that it can only be purchased in the U.S.A.

PetChess was written by Philidor Software especially for ACT/Microsoft for the Pet 3000, 4000 and 8000 series. My review tape occupied almost the entire memory of a 32K 8032 Pet and, for the first time, I realised the privations of those who have to load tapes at 300 baud, although a disc version is also available.

PetChess is claimed to offer more facilities than any other chess software. Setting up positions is exceptionally easy and so is retracing moves. There is, however, no hint button to tell you what to do on your move. An audio alert is also available for the 8000 series. There are 12 levels of play from five seconds to 40 minutes. The graphics are very easy to understand — by way of a change — and the program seems to be crashproof.

There is a substantial book-opening library of 3,700 moves, although whether a computer should play the dubious von Hennig-Schara gambit is open to doubt. Moves may be taken back to the beginning and an action replay is available to repeat moves.

The program uses iterative deepening for its moves and the best move yet found is constantly displayed, as is the move under consideration, and the player can halt the machine's thinking at any time. Moves are not randomly selected — except in the opening — instead the player can select the next best move and play on from there. Draws under the 50-move rule, stalemate or three-fold repetition are also recognised.

The entire program and its style of play is reminiscent of Philidor's Intelligent Chess, although there is a greater emphasis on pawn moves. The evaluation function is evidently very sophisticated, but it takes a long time to search at the lowest levels. It seems that subsequent levels are only sketchily evaluated, and the program rarely changes its mind about a move found at the lowest level. As a result, PetChess falls into simple traps at these levels — up to one minute, which covers half of the available levels — because of its inability to see far ahead.

At higher levels, it avoids the traps, but tends to exchange everything it can. Like so many programs, it likes to exchange its bishops for knights early in the game, and it also prefers to double its pawns rather than move its queen before castling — I detect Levy's hand.

PetChess shows some evidence of strategic thinking in moving pawn majorities against minorities or in moving major pieces into attack positions against the enemy king. This, again, shows the thought that has been put into the evaluation function. The end-game play is, however, rather weak, and the king seems to be a little passive.

PetChess is not as strong as the Sargon II cassette program, which in any case is not available for the Pet in this country. PetChess is certainly the strongest chess program for the Pet available in the U.K. and is good value at £25. Despite my criticisms, I gained a great deal of enjoyment from PetChess and can recommend it to Pet chess players of club standard.

Old standbys

Artic Computing's £15 ZX Chess II is available for the Sinclair ZX-81 with 16K RAM. There are seven levels, searching up to 12 ply ahead. Level 4 — average response time three minutes per move — considers eight ply ahead. The program occupies some 9K of RAM and incorporates a limited book-opening selection. A larger library and random responses may be added at a later date. The graphics are rudimentary, which I regard as an advantage.

Several TV chess games have become available. These include games for the Interton, Atari and Mattel programmable TV units, and for the new Tandy Colour Computer. I have been unable to steel myself to play these after earlier experiences with the dreadful play and incomprehensible graphics of some of their predecessors. Prices are in the range £15 to £50.

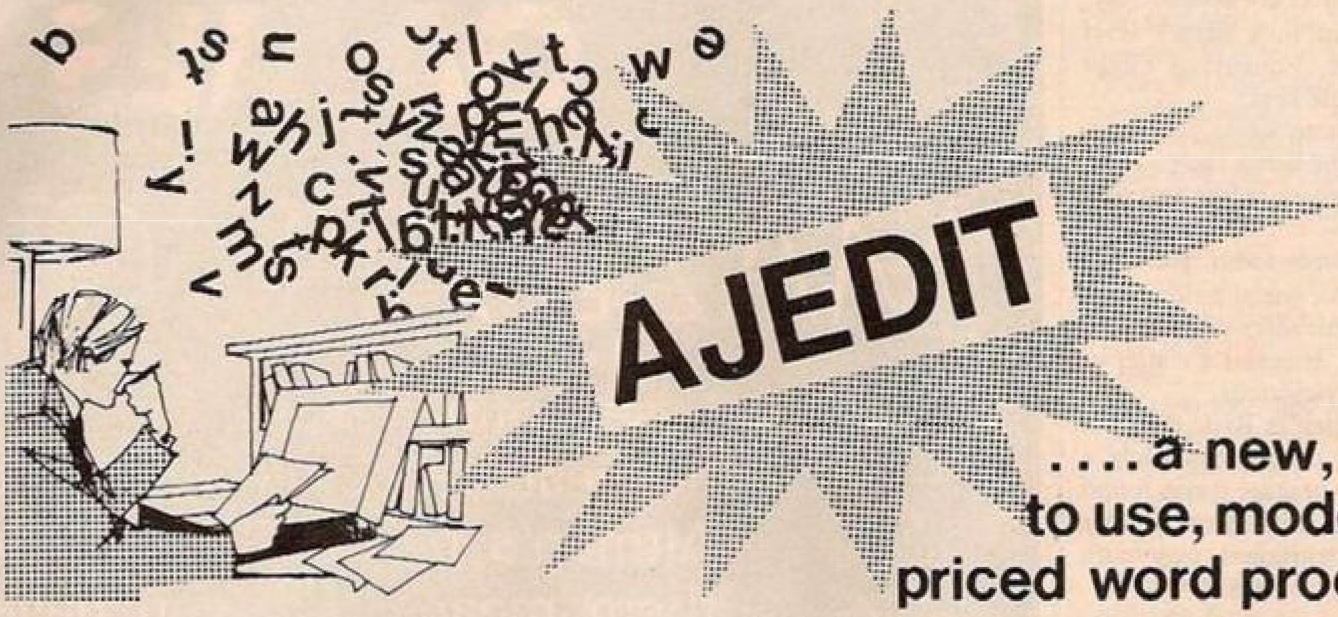
Finally, we must not forget some of the older, but still excellent, chess programs which are available. The Fidelity Sensory 8 is highly commendable at £130 — it is the Challenger 7 with a superb Fidelity sensory board. Although not as fast or as strong as Morphy, Champion Sensory Challenger and the Chess Champion V, it still holds its own against most of the others mentioned in this survey, although it is rather let down by its weak end-game play.

The Sargon II is available on cassette or disc for many home computers at between £15 and £30 and remains one of the most powerful in software. Like all Spracklen-designed games, its end-game play is excellent. ■

CONCLUSIONS

- The Chess Champion Mark V is an excellent machine where much attention has been made to user extras.
- It exhibits some understanding of strategic play. Its tactical play is weaker than that of the Champion Sensory Challenger at equal response times.
- It is cheaper, at £280, than the other two main competitors.
- I can confidently recommend the machine — but do not expect play equivalent to more than ELO 1,900.
- The £120 Super System IV is good value. The optional extras are also relatively inexpensive.
- Pet Chess at £25 is good value for Pet owners with 32K.
- The latest down-market sensory chess machines all play reasonably well. Of these, the Mini Sensory Challenger is superb value at £55.

INNOVATIVE
TRS 80-GENIE SOFTWARE
from the professionals



.... a new, simple to use, moderately priced word processor

The introduction of a brand new word processor is a major event and AJEDIT is without doubt a major program. There are, however, quite a few Word Processors around and most of them are extremely good ones - why, therefore, another? The question is even more pertinent when it is known that we specifically commissioned the writing of it from an author of the status of Denville Longhurst of Enhanced Basic fame. The answer is that user feedback shows that a large number of customers do not need or want word processor programs which require a quantity of training before use. Scripsit, for instance, is an excellent program, but is complex to use; it even comes with a training course on tape. If one operator is dedicated to using the word processor then it makes sense to have her trained, and the more complex the program (so long as the complexity is accompanied by more and bigger functions) the better.

AJEDIT has been written for the user who needs a word processor intermittently, say three or four times a week. Its prime design criteria was ease of use - and just as importantly - ease of recollection of its commands. Take, for instance, the text editing commands - they are as close to the Basic Edit commands as possible, so that the user will remember them: To insert type I, to delete D, to take out three letters type 3D and so on.

Furthermore, AJEDIT has benefited from being written after a number of other word processors. The deficiencies in its predecessors are corrected in AJEDIT. For instance, any control characters can be outputted so that full advantage can be taken of the features of the particular printer being used. Disk directory access is available from within AJEDIT as is the killing of files on the disk. The FREE command and a number of other DOS commands can be carried out from within the program with a return to AJEDIT - with its text intact.

AJEDIT contains close to one hundred commands covering most word processor requirements. Dedicated printer commands for the Epson MX series and the Centronics 737 are included - again for ease of use of these two popular printers.

One of the big features of AJEDIT is the ability to "mail-merge". The facility is available whereby two special files are created, one containing names and addresses and a salutation, the other a standard letter or form. AJEDIT will call the address and salutation from one file and the letter from the other and thereby compile personalised letters. The salutation may be repeated in the body of the letter.

AJEDIT needs 48K and one disk minimum and is suitable for the TRS-80 Models I and III and the Video Genie Models I and II.

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GAMES

MAZE ATTACK



Laser-toting aliens lurk in the deepest recesses of Marcus Altman's maze. But to meet them means that you have already solved the riddle at the heart of the labyrinth.

MAZE ATTACK IS in two parts: the first is an Adventure, the second a space game. The program starts with a random maze where two of your enemies chase you round the labyrinth. The difficulty of the maze and the speed with which the enemy chases you increases with each level.

The idea is to collect three keys which will give you access to the battle room — the second part of the game. These keys are situated behind doors on each level of the maze. The only trouble is that you do not know which door. There could be a monster waiting behind the door you are about to try, or a stairway leading up to a harder level which you have to take. Equally, it might conceal one of the valuable keys.

Once you have the three keys, you automatically gain access to the battle room. Yet if one of the enemy catches you before you find the keys, you die.

Once you are in the battle room, you have four laser bases to control, one at a time. You have to shoot down the invaders who are also firing mercilessly at you. It is just a matter of time until the aliens are victorious.

This program was written in Basic for a Pet and occupies only 3.5K of memory. Only a few subroutines are used because it was found that the 16K Pet ran out of memory after about 15 minutes of continuous play with many subroutines in the program.

With the exclusion of most of the subroutines, the only factor you have to worry about is being blown up by an alien. The program can be converted easily to other machines that have memory-mapped screens and I will explain each individual Poke, Peek and Sys.

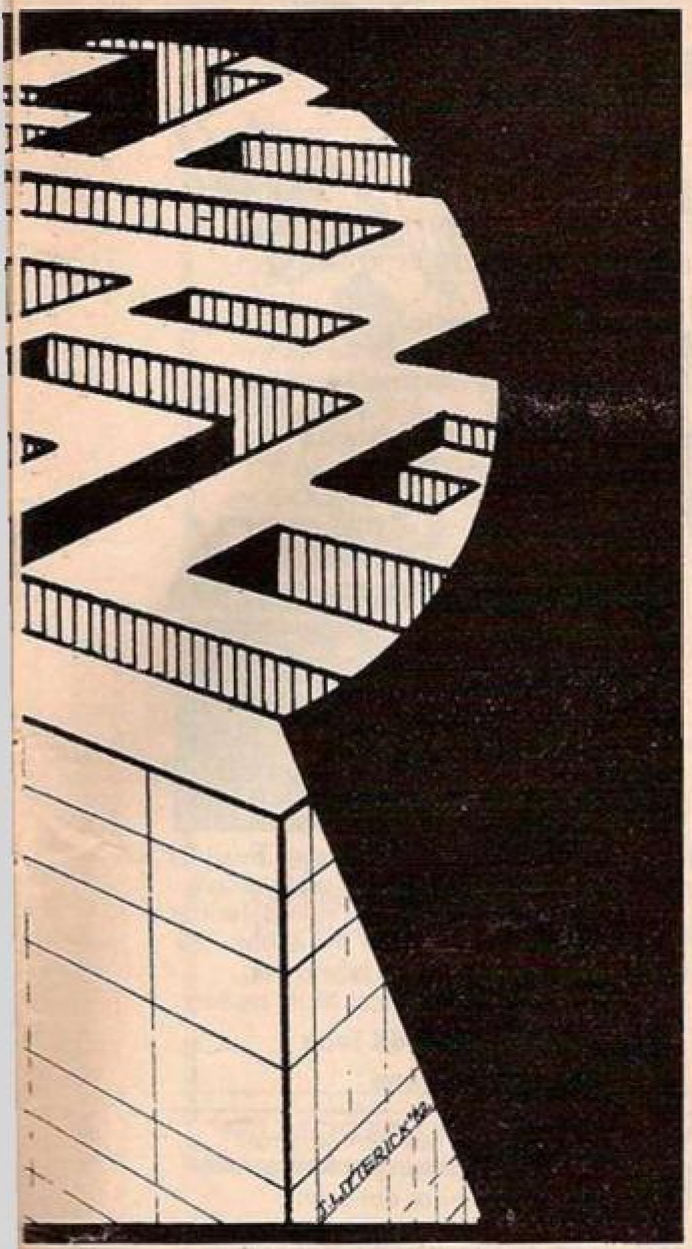
Lines 2-3: B equals the number of squares in the maze, F equals the probability of enemy moving — 1:7.

Lines 70-90 set up the maze. If you have chosen the difficult game, then the maze will be invisible.

Lines 100-130 set up the border of the maze. 32768 is the top left-hand corner of the maze.
Line 191: A is your starting position in the maze

```
READY.

1 PRINT"[CLS]"
2 B=50
3 F=7
4 PRINT"DO YOU WANT INSTRUCTIONS?(Y OR N)."
5 INPUTA$;IFA$<>"Y"THEN9
6 GOTO 3000
9 PRINT"[CLS]";GOTO 2000
10 PRINT"DO YOU WANT TO PLAY THE EASY OR HARD GAME?(E OR H)"
11 GET F$
12 IF F$="H" THEN LL=96
13 IF F$="E" THEN LL=102
14 IF F$="" THEN 11
15 PRINT"[CLS]"
70 FOR A=1 TO B
80 POKE (INT(1000*RND(1)+32768)),LL
90 NEXT
95 REM SET UP BOUNDARIES
100 FOR A=32768 TO 32807:POKE A,102:NEXT
110 FOR A=33728 TO 33768:POKE A,102:NEXT
120 FOR A=32768 TO 33720 STEP40:POKE A,102:NEXT
130 FOR A=32807 TO 33768 STEP40:POKE A,102:NEXT
191 A=32830:D=33539:DD=33559
192 FOR L=32831 TO 32836:POKE L,32:NEXT
193 REM SET UP DOORS
195 FOR G=1 TO 4:POKE (INT(300 *RND(1)+33468)),4:NEXT
196 O=TI
197 REM KEYBOARD SCAN
200 AA=PEEK(151)
201 POKE A,43:POKE D,94:POKE DD,94
205 IF (INT(F*RND(1)+1))=1 THEN GOSUB300
206 REM YOU MOVING
207 IF AA=255 THEN 200
210 IF AA=18 THEN C=40
220 IF AA=50 THEN C=-40
230 IFAA=42THENC=-1
240 IFAA=41THENC=1
250 POKEA,32
255 REM SEE IF YOU'VE HIT ANYTHING
260 IFPEEK(A+C)=LLTHENPOKE(A+C),102:GOTO200
261 IF PEEK(A+C)=102 THEN 200
265 IF PEEK(A+C)=94 THEN 500
267 IF PEEK(A+C)=4 THEN 600
270 A=A+C:POKEA,43
275 IF (INT(F*RND(1)+1))=1 THEN GOSUB 300
280 GOTO 200
290 REM MOVE ENEMY UP AND DOWN
300 IF (A-D)>-20 AND (A-D)<20 THEN 400
301 IF (A-DD)>-20 AND (A-DD)<20 THEN 400
310 IF D<A THEN E=40
311 IF DD<A THEN EE=40
320 IFD>ATHENE=-40
321 IF DD>A THEN EE=-40
330 POKED,32
331 POKE DD,32
335 REM TIMER
336 W=TI-O:W=INT(W/60):IF W>=20  THEN800
337 PRINT"[HOM]";PRINTW
338 IF PEEK(DO+EE)=43 THEN 500
340 D=D+E:POKE D,94
341 DD=DD+EE:POKE DD,94
350 RETURN
360 REM MOVING ENEMY SHIPS SIDEWAYS
400 IF D<A THEN E=1
401 IF DD<A THEN EE=1
410 IF D>A THEN E=-1
411 IF DD>A THEN EE=-1
420 POKE D,32
421 POKE DD,32
425 IF PEEK(D+E)=43 THEN 500
426 IF PEEK(DD+EE)=43 THEN 500
427 DD=DD+EE:POKE DD,94
430 RETURN
500 PRINT"[CLS]"
505 REM THEY GOT YOU
510 PRINT:PRINT:PRINT:PRINT"YOUR DEAD"
520 PRINT:PRINT:PRINT"DO YOU WANT ANOTHER GAME"(Y OR N)
530 INPUT K$:IFK$<>"Y"THEN END
540 RUN
600 PRINT"[CLS]"
610 LET H=INT(7*RND(1)+1)
620 IF H=1 THEN 700
630 IF H=4 THEN 750
635 M1=M1+1
640 PRINT:PRINT:PRINT"O.K LET'S GO UP TO LEVEL ";M1
645 FOR X=1 TO 2000:NEXT
650 B=B+50:F=F-1:IF F<2 THEN F=2
655 IF B>300 THEN B=300
660 PRINT"[CLS]"
665 GOTO 70
700 M=M+1:PRINT"[CLS]":PRINT:PRINT:PRINT"YOU'VE FOUND KEY";M
720 FOR X=1 TO 3000:NEXT
725 IF M=3 THEN RUN 999
730 PRINT"[CLS]":GOTO 70
750 PRINT"[CLS]":PRINT:PRINT:PRINT"O DEAR YOU'VE BEEN EATEN BY A MONSTER";
751 PRINT"   AND............"
760 GOTO 510
800 PRINT"[CLS]"
810 PRINT :PRINT:PRINT"YOU'VE RUN OUT OF TIME AND........."
820 GOTO 510
999 LETZZ=4
1000 PRINT"[CLS]"
1005 X2=33568
1100 REM SET UP SCREEN
1190 P=32775:Q=P+4:R=P+8:S=P+16
1200 FORA=33640 TO 33697:POKEA,102:NEXT
1201 S1=33448:POKES1+10,102:POKES1+11,102
1202 POKES1+20,102:POKES1+21,102:POKES1+30,102:POKES1+31,102
1203 S2=33488:POKES2+10,102:POKES2+11,102:POKES2+20,102:POKES2+21,102
1204 POKES2+30,102:POKES2+31,102
1210 B=33610:C=112:D=113:E=110:F=32769:G=33645:H=B
1220 I=24:J=22:K=10:L=32:M=151
1230 POKEB,C:POKEB+1,D:POKEB+2,E
```



— middle of the top line. D and DD are the starting positions of the enemy, near the bottom of the maze.

Line 192 clears a space next to you so that you are not blocked in by the maze.

Line 195 sets up position of doors near the bottom of the maze.

Line 196: TI on the Pet is the function to call the clock.

Line 200: Peek (151) is the keyboard scan for the Pet and it allows for the return of a value for the key being pressed until that key is no longer pressed.

Line 201: 43 is the graphic code for + and 94 is the graphic code for π.

Line 205: this random function decides whether the enemy are going to move or not.

Lines 207-240: AA is the value obtained from Peek (151) and 255 is the value when no key is being pressed. 18 is the value for the key 2; 50 is the value for the key 8; 42 is the value for the key 4 and 41 is the value for the key 6.

Line 250: 32 is the graphic code for a blank space.

Line 260 checks to see if you have hit anything on the invisible maze and then makes it appear.

Lines 261-267 check to see if you have hit a square — graphic code 102 — a π — graphic code 94 — or a door — graphic code 4.

Line 270 moves you.

Line 275 is the same as line 205.

Lines 300-301 check to see if the enemy is on the same line as you.

Lines 310-331 moves enemy up or down depending on your position.

Line 336 converts the Pet clock into seconds for the timer of the game.

Lines 338-350 check to see if the enemy have caught up with you and move the enemy.

Lines 400-430 do the same as 300-350, but the enemy moves sideways.

Lines 500-540 are the endings.

Lines 600-630 decide whether there is to be a key, monster or staircase behind a door.

Lines 635-662 move you up to a more difficult level. More squares, B, and the enemy move faster, F.

Lines 700-735 are where you find a key.

Lines 750-760 are where you meet a monster.

Lines 800-830 are where you run out of time.

Line 999: ZZ is the number of lives.

Line 1005: X2 is three lines above the bottom line of the screen.

Line 1190: P,Q,R,S are the positions of the enemy.

Line 1200 draws the bottom line of the screen, graphic code 102 is for a square.

Lines 1201-1204 set the barriers.

Line 1210: B is the starting position for the laser base. C,D,E are the graphic codes for the laser base. F is the top-left hand corner of the screen. G is the furthest position, right, that the laser base can move.

Line 1220: 32 is the graphic code for a blank square. M is for the keyboard scan. 24 is the value from the keyboard scan for X. 10 is for 0 and 32 is for Z.

Line 1230 sets up the laser base.

Line 1240 is the keyboard scan.

Line 1250 goes to firing lines.

Lines 1260-1270 move the laser base.

Lines 1330-1440 move the enemy one at a time in the direction FF, i.e., sideways or down. RR is the flag to jump back to the correct line after line 1410 — it saves a subroutine. Z is the score.

Lines 1500-1545 deal with the laser bases' firing. 30000 is a convenient location in free RAM where the enemy are put after being hit. 42 is the graphic code for *.

Lines 1600-1650 are the enemy firing. The 16 cursor downs and the Print in lines 1620-1630 is to clear away the bullets when they have reached the bottom. These lines also contain the ability for the laser base to move. A For-Next loop is avoided here because of the difficulty of jumping out of it.

Lines 1800-1814 are the endings. ZZ is the variable of lives left. Sys (826) calls the machine-code subroutine which flashes the whole screen on and off in reverse video for a spectacular effect.

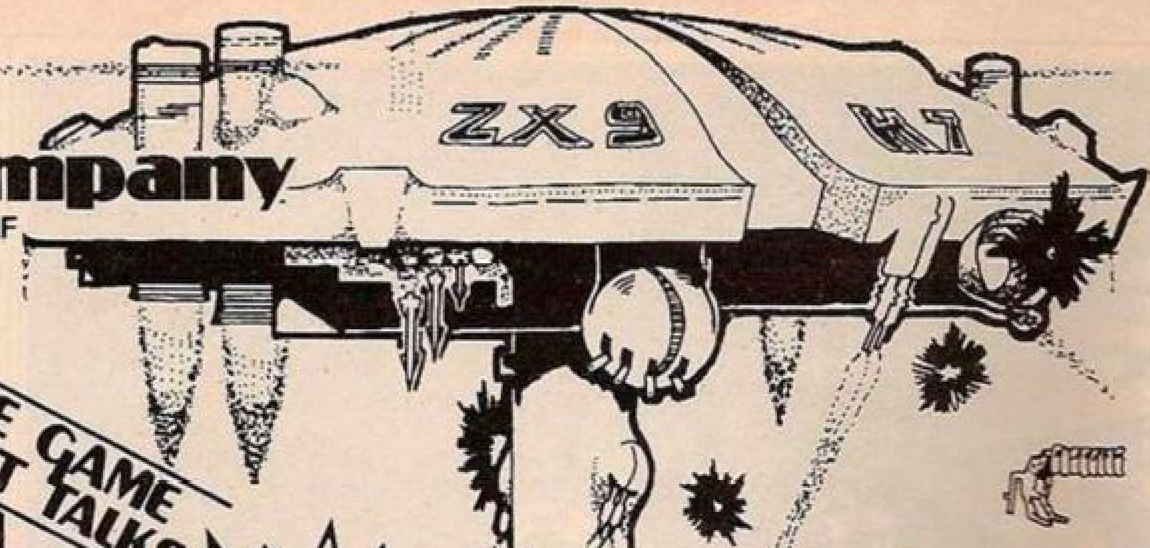
Lines 2000-2020 is the reverse-video routine.

Lines 3000-3260 are the instructions. ■

```
1235 REM KEYBOARD SCAN AND MOVE YOU
1240 N=PEEK(M):IFN<>KANDN<>IANDN<>JTHEN1320
1250 IFN=KTHEN1500
1260 IFN=IANDB<GTHENPOKEB,32:B=B+1:POKEB,C:POKEB+1,D:POKEB+2,E:GOTO1320
1270 IFN=JANDB>HTHENPOKEB+2,32:B=B-1:POKEB,C:POKEB+1,D:POKEB+2,E
1320 GG=GG+1:IFGG=8THENGG=1
1325 REM MOVE ENEMY
1330 ONGGGOTO1339,1349,1359,1369,1240,1240,1240,1240
1339 IFP<32000THEN1349
1340 T=P:RR=1:GOTO1400
1341 P=T:GOTO1240
1349 IFQ<32000THEN1359
1350 T=Q:RR=2:GOTO1400
1351 Q=T:GOTO1240
1359 IFR<32000THEN1369
1360 T=R:RR=3:GOTO1400
1361 R=T:GOTO1240
1369 IFS<32000THEN1339
1370 T=S:RR=4:GOTO1400
1371 S=T:GOTO1240
1380 REM LEFT? RIGHT? DOWN?
1400 LETEE=INT(10*RND(1)+1):FF=40:IFEE=2THENFF=1
1402 IFEE=1THENFF=-1
1404 T=T+FF:IFPEEK(T)=32ORPEEK(T)=88THENPOKET-FF,32:POKET,88
1405 IFT>=33568THEN510
1407 PRINT"[HOM]":PRINTZ:IFPEEK(T)=102 THENEND
1410 IF(INT(2*RND(1)+1))=1THEN1600
1411 IFRR=1THEN1341
1412 IFRR=2THEN1351
1413 IFRR=3THEN1361
1414 IFRR=4THEN1371
1440 END
1500 X=B-39:FORY=XTOFSTEP-40:IFPEEK(Y)=LTHENPOKEY,93:NEXTY:GOTO1530
1501 REM YOU'RE FIRING
1505 IFPEEK(Y)=93THENYY=X:GOTO1530
1506 IFPEEK(Y)=102 THEN 1530
1510 Z=Z+1:POKEY,42:POKEY,32:IFY=PTHENP=30000
1512 IFY=QTHENQ=30000
1513 IFY=RTHENR=30000
1514 IFY=STHENS=30000
1515 IFP<32000ANDQ<32000ANDR<32000ANDS<32000THEN1000
1530 AA=Y:FORY=XTOAASTEP-40:POKEY,L:NEXT
1540 POKEYY,32
1545 GOTO 1320
1550 REM IT'S FIRING
1600 YY=T+80
1601 YY=YY+40:IFPEEK(YY)<>LTHENPOKEYY,L:POKEYY-40,L:GOTO 1647
1610 POKEYY-40,32:POKEYY,93
1611 N=PEEK(M):IFN<>KANDN<>IANDN<>JTHEN1646
1612 IFN=IANDB<GTHENPOKEB,32:B=B+1:POKEB,C:POKEB+1,D:POKEB+2,E:GOTO1646
1613 IFN=JANDB>HTHENPOKEB+2,32:B=B-1:POKEB,C:POKEB+1,D:POKEB+2,E:GOTO1646
1614 IFN=KTHEN1615
1615 X=B-39:FORY=XTOFSTEP-40:IFPEEK(Y)=LTHENPOKEY,93:NEXTY:GOTO1623
1616 IFPEEK(Y)=93THEN1900
1617 IFPEEK(Y)=102THEN1623
1618 Z=Z+1:POKEY,42:POKEY,32:IFY=PTHENP=30000
1619 IFY=QTHENQ=30000
1620 IFY=RTHENR=30000
1621 IFY=STHENS=30000
1622 IFP<32000ANDQ<32000ANDR<32000ANDS<32000THEN1000
1623 AA=Y:FORY=XTOAASTEP-40:POKEY,L:NEXTY
1624 POKEYY,32
1646 IF YY< 33528THEN1601
1647 IFPEEK(YY+80)=113ORPEEK(YY+80)=110ORPEEK(YY+80)=112THEN1800
1648 PRINT"[16 CD]"
1649 PRINT"
1651 GOTO1411
1800 ZZ=ZZ-1
1805 REM ENDINGS
1806 ZZ$="LIVES"
1807 IFZZ=1THENZZ$="LIFE"
1808 PRINT"YOU'VE GOT";ZZ; ZZ$;" LEFT"
1809 FOR I3=1 TO 20 :FORI4=1TO20:NEXTI4:SYS(826):NEXTI3
1810 FORE3=1 TO 200 :NEXTE3
1812 IFZZ=0 THENPRINT"END OF GAME":GOTO520
1814 GOTO 1000
1900 AA=Y:FORY=X TO AA STEP-40:POKEY,L:NEXTY:GOTO 1411
1999 REM MACHINE CODE ROUTINE TO PUT WHOLE SCREEN INTO REVERSE VIDEO
2000 FORI1=826 TO 852:READJ1:POKEI1,J1:NEXT
2010 DATA 162,128,134,2,169,0,133,1,202,160,0,177,1,73,128
2020 DATA 145,1,200,208,247,230,2,224,124,208,238,96
2030 GOTO 10
2999 REM INSTRUCTIONS
3000 PRINT"[CLS]"
3010 PRINT"YOU HAVE BEEN HIRED BY THE ZUGS TO REPEL"
3020 PRINT"THE CUZANGS WHO ARE INVADING THE ZUG'S"
3030 PRINT:PRINT"PLANET.YOU HAVE ARRIVED A LITTLE TOO"
3040 PRINT:PRINT"LATE AND 2 OF THE CUZANGS HAVE ENTERED"
3050 PRINT:PRINT"THE ZUG'S MAIN CONTROL STATION.YOU"
3060 PRINT:PRINT"HAVE BEEN TOLD BY A FRIENDLY ZUG"
3070 PRINT:PRINT"THAT YOU HAVE TO PICK UP 3 KEYS TO"
3080 PRINT:PRINT"BE ABLE TO ENTER THE BATTLE ROOM"
3090 PRINT:PRINT"AND THESE KEYS CAN BE FOUND BEHIND THE"
3100 PRINT:PRINT"DOORS ON THE VARIOUS LEVELS OF THE BUILDING"
3110 PRINT"[REV] PRESS ANY KEY TO CONTINUE [OFF]"
3120 GET A$:IFA$=""THEN3120
3130 PRINT"[CLS]"
3140 PRINT"YOU ARE THE SHAPE "+" AND THE 2 INVADERS"
3150 PRINT"ARE "*"."
3160 PRINT:PRINT"TO MOVE THROUGH THE BUILDING USE THE KEYS:"
3170 PRINT:PRINT"[REV]2=DOWN    8=UP    4=LEFT    6=RIGHT[OFF]"
3180 PRINT:PRINT"REMEMBER ALWAYS GO FOR A DOOR"
3190 PRINT:PRINT"THE INVADERS WILL EAT YOU IF THEY CATCH YOU";
3200 PRINT" AND THERE ARE SOME MONSTERS BEHIND  SOME DOORS!!"
3210 PRINT:PRINT"WHEN YOU GET INTO THE BATTLE ROOM"
3220 PRINT:PRINT"YOU HAVE 3 BASES AND TO MOVE:"
3230 PRINT:PRINT"[REV]Z=LEFT    X=RIGHT    0=FIRE[OFF]"
3235 PRINT"P.S YOU ONLY HAVE 20SECS TO GET OUT OF  EACH LEVEL IN THE BUILDING"
3240 PRINT"[REV]PRESS ANY KEY TO CONTINUE.[OFF]"
3250 GET A$:IFA$=""THEN3250
3260 GOTO 9
READY.
```

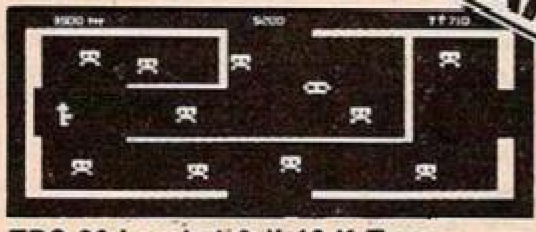
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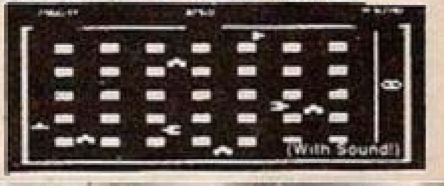


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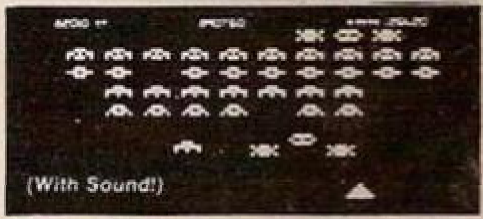
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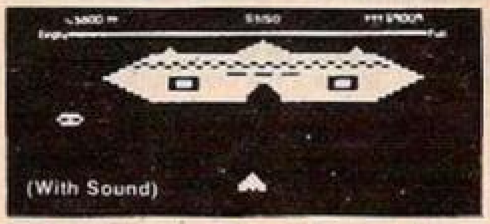
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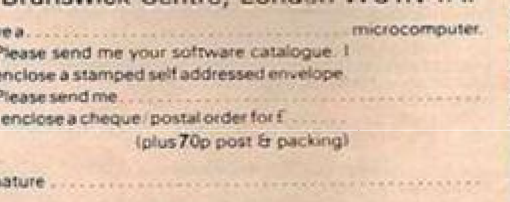


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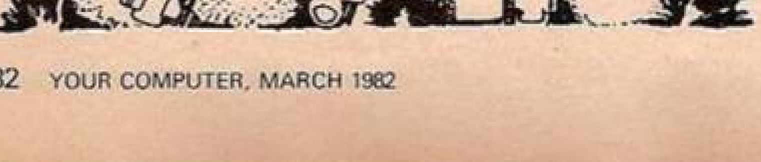
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ZX-81 MUSIC

The ZX-81 may not be renowned for its dulcet tones, but passable music is well within its capabilities without hardware modifications. John Sylvester shows how.



THE ZX-81 HAS one major failing when it comes to creating music — it cannot use the video and create sound at the same time. Nevertheless, you can obtain pleasing results with the notes which cover an eight-octave range complete with semitones. The notes are at first estimated, and then fine-tuned with the aid of an electric organ. This is, of course, no guarantee that the final result is correct.

To hear the music generated, you can use a cassette recorder in record mode and, if available, use the monitor facility or feed the cassette output through a suitable amplifier.

The easiest wave-form to produce on a computer is that of a square wave, since this is a simple switching pattern. The number of times the wave-form is switched in one second denotes the frequency of the output. Figure 1 shows a square wave.

The time taken to complete one cycle is called the periodic time and in figure 1 is shown by t1. t2 and t3 are the times during which the wave-form is switched on and off. The periodic time is the reciprocal of the frequency in hertz or cycles per second.

If the frequency is 50Hz, the periodic time is 20ms., so t2 and t3 equal 10ms. each. If the periodic time is increased, the frequency decreases and conversely, if the periodic time is decreased, the frequency increases.

Now that we have seen how to produce a frequency by switching on and off, the question arises as to how to use the ZX-81 to achieve the same effect. J Chalmers, in Software File, December issue, suggested a simple circuit which would allow you to do this. However, the capability is built into the ZX-81 and there is no need for extra circuits.

Listening to a recording of a saved program you will notice that there is a definite variation in frequency. So, if we can discover how this is done, we can use the cassette port to produce our frequencies.

Without describing in detail the exact working of the cassette circuitry, it is sufficient to know that the output to the cassette is via port FF. This alone will not produce any response. After extensive experimenting I found that port FE was also involved, so that the instructions

OUT (FF),A

turned the cassette port on and

IN A,(FE)

turned it off. We now have the necessary data to produce the switching required.

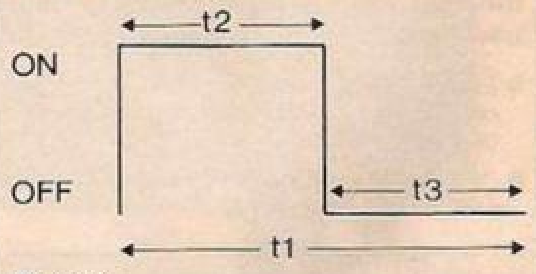


Figure 1.

Listing 1 contains machine code to control the cassette output. From the listing you will see that after output and input, there is a delay which produces the time required for t2 and t3. The length of note is determined by Time and this is decremented by the half-cycle count after one complete cycle. This means for a given value in Time, the duration of all notes is constant.

The machine code is placed in the Rem statement of Basic at line 1. Listing 2 gives a Basic program to be used in conjunction with the machine code. Lines 10 to 180 calculate

Listing 1. Machine code.

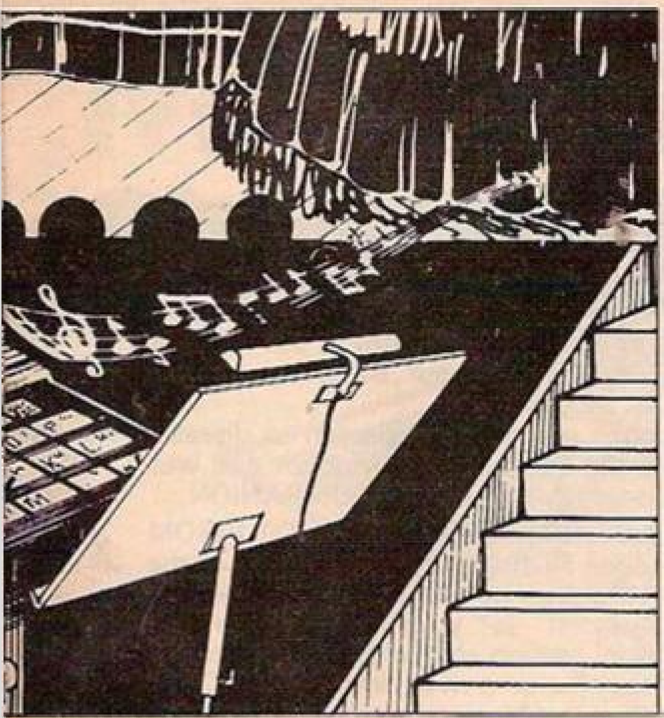
```
4082 FF 00          TIME   00FF            :DURATION COUNT
4084 00 00          FREQ   0000            :NOTE COUNT
4086 2A 82 40              LD    HL,(TIME)
4089 ED 5B 84 40           LD    DE,(FREQ)
408D 01 00 00              LD    BC,0
4090 E5            CYCLE   PUSH  HL        :SAVE DURATION ON STACK
4091 D3 FF                 OUT   (FF),A    :TURN ON CASSETTE PORT
4093 CD A2 40              CALL  DELAY
4096 DB FE                 IN    A,(FE)    :TURN OFF CASSETTE PORT
4098 CD A2 40              CALL  DELAY
409B E1                    POP   HL        :GET DURATION FROM STACK
409C B7                    OR    A         :CLEAR CARRY FLAG
409D ED 52                 SBC   HL,DE     :DECREMENT DURATION BY
                                            ONE HALF CYCLE
409F 30 EF                 JR    NC,CYCLE  :GO DO ANOTHER CYCLE
40A1 C9                    RET             :RETURN TO BASIC
40A2 2A 84 40      DELAY   LD    HL,(FREQ) :GET DELAY FOR ONE HALF
                                            CYCLE
40A5 37             LOOP   SCF             :SET CARRY FLAG
40A6 ED 42                 SBC   HL,BC     :DECREMENT DELAY BY ONE
40A8 30 FB                 JR    NC,LOOP   :DELAY NOT DONE
40AA C9                    RET             :RETURN TO CALLER

NOTES:
1. VALUE IN FREQ MUST NEVER BE 0, OR PROGRAM WILL LOOP
   INDEFINITELY.
2. DURATION IS DETERMINED BY LOC 4083, LOC 4082 ALWAYS FF.
3. COUNT FOR A GIVEN FREQUENCY IS FOUND BY, 1/(F*17E-6).
```

Listing 2. The Basic program.

```
  1 REM ** THIS LINE WILL HOLD THE MACHINE CODE **
  9 REM ** INITIALISE VARIABLES **
 10 DIM O$(8,7,2)
 15 FAST
 20 FOR J=1 TO 8
 30 LET N=1
 39 REM ** CALCULATES NOTE A **
 40 LET F=INT((26*2**(J-1)+2**(J-1)*(2/3))+.5)
 50 GOSUB 300
 59 REM ** CALCULATES NOTE B **
 60 LET F=INT((30*2**(J-1)+.5)
 70 GOSUB 300
 79 REM ** CALCULATES NOTE C **
 80 LET F=INT((32*2**(J-1)+.5)
 90 GOSUB 300
 99 REM ** CALCULATES NOTE D **
100 LET F=INT((36*2**(J-1)+.5)
```

(listing continued on next page)



the frequency of a given note in a specific octave; lines 300 to 330 calculate the counts to give the half-cycle delays necessary to produce the required frequencies. To raise or lower the pitch of all octaves the value of 17E-6 in line 300 may be altered. All the counts calculated are stored as characters in the array 0$.

Lines 190 to 196 play an introductory tune after the initialisation of the array. The user

Variable	Use
0$	Array for holding the counts for the relevant frequencies
J	Octave pointer for array 0$
N	Note pointer for array 0$
X$	Octave string
N$	Note string
D$	Duration string
F	Calculation of frequency and MSD of count for frequency
X	String pointer used with X$, N$ and D$
F1	LSD of count for frequency
T	Pause count
SF	Semitone flag for direct-keyboard operation

Glossary.

can specify notes, octaves and duration of the notes in lines 200 to 260. Notes are entered using A to G; semitones are indicated by inverse A,B,D,E and G; a pause by entering a space at the required point is performed in lines 1200 to 1220.

Octaves are indicated by 1 to 8, and the duration by 0 to F. Lines 1000 to 1110 constitute the subroutine which scans the input data. They also retrieve the correct counts from the array and Poke them into the locations in the machine code. The machine-code program is then entered.

Lines 1500 to 1620 calculate the values of the semitones and Poke them into the correct locations. Lines 2000 to 2065 allow the user to play direct from the keyboard. The octave is selected by pressing the keys 1 to 8, and the notes by keys A to G. If a semitone is required, the S key is pressed before the note. The duration in this mode is set to 1 — line 2050. Press K to return to the normal mode.

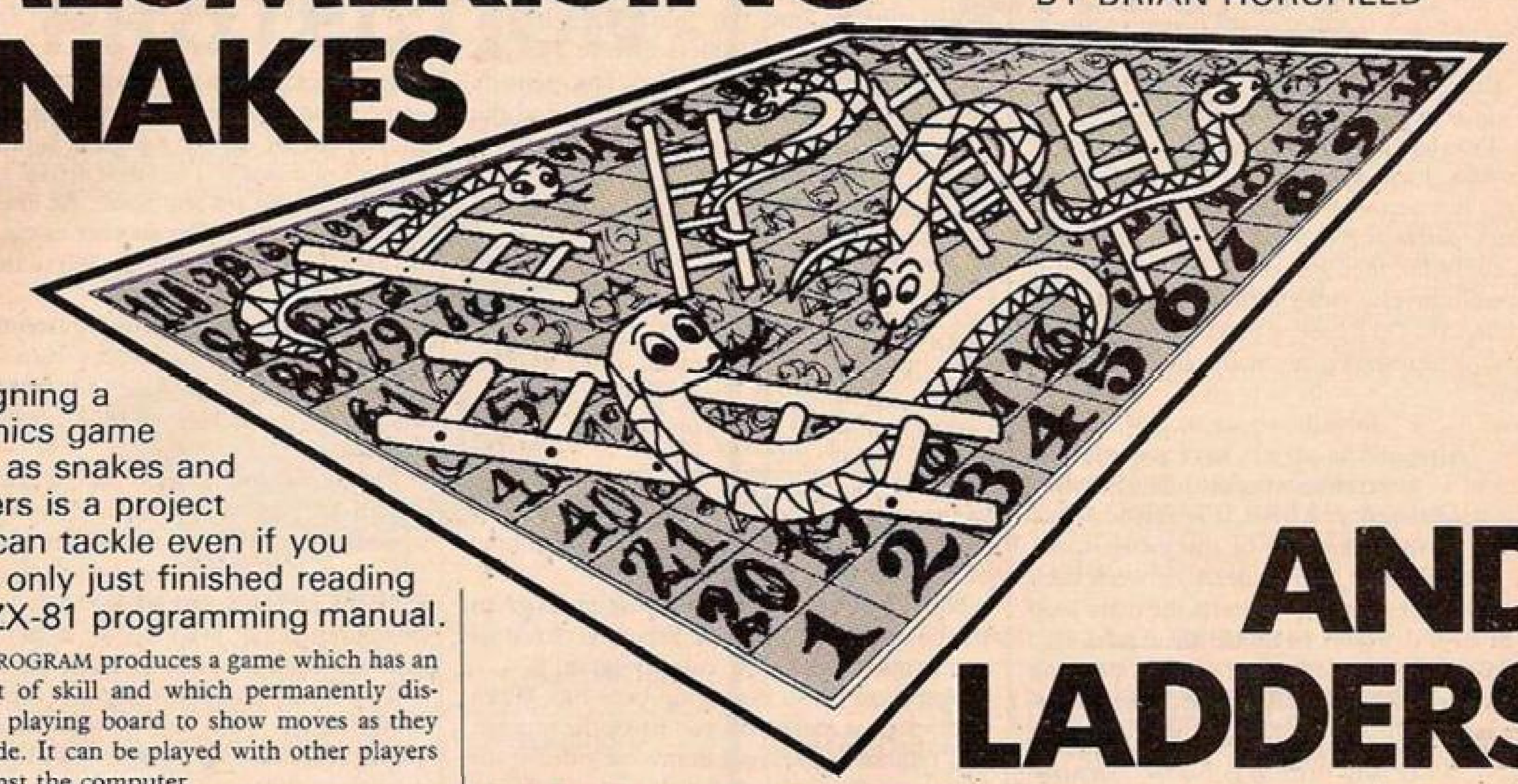
You can use the machine-code routine to produce sound effects by Poking the locations with the counts to achieve the correct frequency and duration. ■

(listing continued from previous page)

```
110 GOSUB 300
119 REM ** CALCULATES NOTE E **
120 LET F=INT((40*2**(J-1)+.5)
130 GOSUB 300
139 REM ** CALCULATES NOTE F **
140 LET F=INT((42*2**(J-1)+2**(J-1)*(2/3))+.5)
150 GOSUB 300
159 REM ** CALCULATES NOTE G **
160 LET F=INT((48*2**(J-1)+.5)
170 GOSUB 300
180 NEXT J
189 REM ** PLAY INTRODUCTORY TUNE **
190 LET X$="333333343 3333333"
191 LET N$="CEGGGGGCG EFGGFDC"
195 LET D$="11333371111144448"
196 GOTO 270
199 REM ** INPUT DATA - K TRANSFERS CONTROL DIRECT TO KEYS **
200 PRINT "NOTES A-G"
204 INPUT N$
205 IF N$(1)="K" THEN GOTO 2000
210 PRINT "OCTAVES 1-8"
230 INPUT X$
250 PRINT "DURATION 0-F"
260 INPUT D$
270 GOSUB 1000
275 CLS
280 GOTO 200
299 REM ** CONVERT NOTES TO FREQUENCY COUNT **
300 LET F=INT((1/(F*17E-6))+.5)
305 LET 0$(J,N,2)=CHR$(F-(INT(F/256)*256))
310 LET 0$(J,N,1)=CHR$(INT(F/256))
320 LET N=N+1
330 RETURN
999 REM ** START PLAYING TUNE **
1000 FOR X=1 TO LEN N$
1010 LET N=CODE N$(X)-37
1020 LET J=CODE X$(X)-28
1030 LET D=(CODE D$(X)-28)*16
1039 REM ** TEST FOR SEMITONE **
1040 IF N>128 THEN GOTO 1500
1044 REM ** TEST FOR PAUSE **
1045 IF N<0 THEN GOTO 1200
1050 POKE 16516,CODE 0$(J,N,2)
1060 POKE 16517,CODE 0$(J,N,1)
1070 POKE 16515,D
1080 LET C=USR 16518
1090 NEXT X
1110 RETURN
1199 REM ** PAUSE ROUTINE **
1200 FOR T=1 TO D*8
1210 NEXT T
1220 GOTO 1090
1499 REM ** SEMITONE GENERATOR **
1500 LET N=N-128
1505 IF N=1 OR N=2 OR N=4 OR N=5 OR N=7 THEN GOTO 1510
1506 STOP
1510 IF N=1 THEN GOTO 1600
1520 LET F=256*CODE 0$(J,N-1,1)+CODE 0$(J,N-1,2)
1530 LET F1=256*CODE 0$(J,N,1)+CODE 0$(J,N,2)
1540 LET F=INT((F1+F)/2+.5)
1550 LET F1=F-(INT(F/256)*256)
1560 LET F=INT(F/256)
1570 POKE 16516,F1
1580 POKE 16517,F
1590 GOTO 1070
1600 LET F=256*CODE 0$(J,N,1)+CODE 0$(J,N,2)
1610 LET F1=256*CODE 0$(J-1,7,1)+CODE 0$(J-1,7,2)
1620 GOTO 1540
2000 LET SF=0
2002 IF INKEY$="" THEN GOTO 2002
2010 LET N$=INKEY$
2015 IF N$="K" THEN GOTO 200
2020 IF N$="S" THEN LET SF=1
2030 IF N$>"0" AND N$<"9" THEN LET X$=N$
2040 IF N$<"A" OR N$>"G" THEN GOTO 2002
2045 IF SF=1 THEN LET N$=CHR$(CODE N$+128)
2050 LET D$="1"
2055 LET SF=0
2060 GOSUB 1000
2065 GOTO 2002
```

MESMERISING SNAKES AND LADDERS

BY BRIAN HORSFIELD



Designing a graphics game such as snakes and ladders is a project you can tackle even if you have only just finished reading the ZX-81 programming manual.

THIS PROGRAM produces a game which has an element of skill and which permanently displays a playing board to show moves as they are made. It can be played with other players or against the computer.

The program is built up in stages starting with important subroutines which are then lined together by a main program loop.

The game is played on a 10-by-10 grid with 100 bases. The bases are numbered and the numbers move up the grid as shown in figure 1. This can be achieved on the screen using Print At giving each base its own pair of line and column numbers. These numbers are stored in two arrays. Type program 1 into your ZX-81 — it will produce a simple grid.

Add line 1145 Slow if you want to watch the grid display forming. Line 1060 decreases the screen line number by two when a group of 10 bases has been allotted its line numbers. Line 1080 decides whether the base column numbers will number from 2 to 29 at line 1090 or from 29 to 2 at line 1110. Note that the bottom three screen lines are free for messages or instructions.

Program 1.

```
1000 DIM L(100)
1010 DIM C(100)
1020 FAST
1030 LET B=0
1040 LET E=0
1050 FOR F=1 TO 100
1060 IF F=11 OR F=21 OR F=31 OR F=41
     OR F=51 OR F=61 OR F=71 OR F=81 OR
     F=91 THEN LET E=E+2
1070 LET L(F)=18-E
1080 IF F>10 AND F<21 OR F>30 AND
     F<41 OR F>50 AND F<61 OR F>70 AND
     AND F<81 OR F>90 THEN GOTO 1110
1090 LET C(F)=2+B
1100 GOTO 1120
1110 LET C(F)=29-B
1120 LET B=B+3
1130 IF B=30 THEN LET B=0
1140 NEXT F
1160 FOR F=1 TO 100
1180 PRINT AT L(F),C(F);"□"
1220 NEXT F
RUN NEWLINE
```

(listing continued on next page)

Add program 2 to the program. It will number the bases. Lines 1170 and 1180 print the first nine digits in inverse video. Line 1190 deals with the numbers 10 to 99 by printing the tens and units separately. Number 100 is catered for separately.

Next the snakes and ladders bases need to be identified. You can choose any locations for these bases and identify them in your own way. I have located seven of each with the ladders, LL, located towards the lower part of the grid display and the snakes, SS, towards the upper part.

```
1200 IF F=24 OR F=30 OR F=54 OR F=64 OR
     F=87 OR F=93 OR F=98 THEN PRINT
     AT L(F),C(F);"SS"
1210 IF F=7 OR F=15 OR F=19 OR F=35 OR
     F=50 OR F=60 OR F=71 THEN PRINT
     AT L(F),C(F);"LL"
```

Moves in the board game are normally made on the roll of a die. The ZX-81 can produce random numbers. However, to introduce a measure of skill into the game, program 3 can be used to decide each move.

This subroutine, starting at line 600, sets a pixel moving quickly across the bottom of the screen. Pressing key P takes the program out of the subroutine with the value of X fixed at the value it had when the P key was pressed. The value of X, which may be 4, 14, 24, 34, 44 or 54, is converted at line 250 into a number from 1 to 6.

The value of Step in line 620 may be altered to 5 without altering the ratio of chances of catching one of the digits 1 to 6. Line 710 takes the program back into the subroutine loop if key P has not been pressed.

The Print statements on lines 310 and 600 must contain the same number of symbols, including spaces, so that they will completely erase one another. Now type in the main stem of the listing — program 4 — including the

(continued on next page)

(continued from previous page)

main loop which starts at line 200.

Array P stores each player's position on the grid. All the positions are initially set at zero. The value of X is added to the player's score at line 410 and then variable Y is given the value of the player's position. This is to avoid having to type in P(J) too many times — see line 450 and later in the subroutine starting at line 800. Line 450 restores a base after the player has occupied it and then moves on.

Each player is represented by a letter, A, B, C and D for four players. The letter is displayed in inverse video with the player's name by line 210. On a base, a player is represented by his letter shown normally and in inverse video.

Variable U, initially set at 0, is given the value 1 after all the players have started. The value of U determines whether line 450 needs to be used to restore a base. It is obviously not needed at the beginning of the game. Lines 480 and 490 give a short delay between each player's move. Line 510 restarts the main loop when all the players have had their turn.

The snakes and ladders are not yet operating and worse still the snake and ladder bases disappear when a man lands on them and then passes on. This situation is improved by adding program 5.

A check is made to see whether a player has landed on a ladder, line 800, or a snake, line 810. Then the program returns to the main program if neither situation has arisen or moves further into the subroutine. In this program, snakes and ladders involve a loss or gain of 16 bases respectively. The player's position is changed, line 840 or 880, and the appropriate message is displayed at the bottom

Figure 1.

```
COLUMN -    2   5   8  11  14  17  20  23  26  29
LINE     0 100  99  98  97  96  95  94  93  92  91
         2  81  82  83  84  85  86  87  88  89  90
         4  80  79  78  77  76  75  74  73  72  71
         6  61  62  63  64  65  66  67  68  69  70
         8  60  59  58  57  56  55  54  53  52  51
        10  41  42  43  44  45  46  47  48  49  50
        12  40  39  38  37  36  35  34  33  32  31
        14  21  22  23  24  25  26  27  28  29  30
        16  20  19  18  17  16  15  14  13  12  11
        18   1   2   3   4   5   6   7   8   9  10
```

of the screen. Line 220 removes the messages from the bottom of the screen at the beginning of the next player's turn.

Note that P(J), the player's position, is given the possibly new value of Y before returning to the main loop. Now enter program 6.

You must finish exactly on base 100. When your catch is more than you need, the number you require is displayed in inverse video at the bottom of the screen and play passes on to the next player. Lines 370 and 380 enable you to go right into another game should you require it.

280 FOR I = 1 TO P
290 IF P(J) + X = P(I) THEN GOTO 230
300 NEXT I

These lines prevent two players occupying the same ordinary base. However, more than one player can be at the top of a ladder or the bottom of a snake. The latest arrival shows up but any others are still there. At line 290 the Goto allows the player another catch. It could be used to move play to line 480 so that a turn is lost.

Program 7 causes a player's current position to be highlighted during his turn before a catch is made. The base displayed flashes alternately from A[A] to [A]A until key P is pressed.

Finally, if you do not have a friend with whom to play the game, and want to play against the computer, then enter program 8. The string %ZX81% in lines 160 and 230 must be identical and six symbols long. The computer cannot press key P, so at line 270 a random number is chosen to be its catch.

The game is now complete except for any modifications you might want to make — perhaps to make each player start by catching a six. ■

(listing continued from previous page)

Program 2.

```
      1150 LET C(100)=1
 EDIT 1160 FOR F=1 TO 99
      1170 IF F>9 THEN GOTO 1190
 EDIT 1180 PRINT AT L(F),C(F);CHR$128;
           CHR$(F+156)
      1190 PRINT AT L(F),C(F);CHR$(INT
           (F/10)+156);CHR$(F-10*INT(F
           /10)+156)
      1230 PRINT AT L(100),C(100);"[100]"
```

Program 3.

```
 190 GOSUB 600
 240 GOSUB 1000
 250 LET X=INT((X+10)/10)
 310 PRINT AT 20,16;"YOU CAUGHT A """;X;""""
 360 PAUSE 9999
 600 PRINT AT 20,16,"%%%PRESS ""P""%%%%"
 620 FOR X=4 TO 54 STEP 10
 670 PLOT X,0
 680 IF INKEY$="P" THEN GOTO 720
 690 UNPLOT X,0
 700 NEXT X
 710 GOTO 620
 720 RETURN
1240 SLOW
1250 RETURN
```

Program 4.

```
 20 LET U=0
 30 PRINT AT 5,5;"SNAKES AND LADDERS"
 40 PRINT AT 15,0;"HOW MANY PLAYERS? 2-4"
 50 INPUT P
 60 IF P<2 OR P>4 THEN GOTO 50
 70 DIM P$(P)
 80 DIM P(P)
 90 FOR F=1 TO P
100 PRINT "NAME OF PLAYER ";F;"?"
110 INPUT P$(F)
120 LET P(F)=0
130 NEXT F
140 CLS
200 FOR J=1 TO P
210 PRINT AT 20,0;CHR$(J+165);CHR$0;P$(J);"S TURN"
320 IF P(J)+X<100 THEN GOTO 410
410 LET P(J)=P(J)+X
420 LET Y=P(J)
430 PRINT AT L(Y),C(Y);CHR$(J+165);CHR$(J+37)
440 IF U=0 THEN GOTO 460
450 PRINT AT L(Y-X),C(Y-X);CHR$(INT((Y-X/10)+156);
    CHR$(Y-X-10*INT((Y-X)/10)+156)
460 IF J=P THEN LET U=1
480 FOR F=1 TO 60
490 NEXT F
500 NEXT J
510 GOTO 200
```

Program 5.

```
 10 LET L$=" 32 SPACES "
220 PRINT AT 21,0;L$
470 GOSUB 800
800 IF Y=7 OR Y=15 OR Y=19 OR Y=35 OR Y=50 OR Y=60
    OR Y=71 THEN GOTO 830
810 IF Y=24 OR Y=30 OR Y=54 OR Y=64 OR Y=87 OR
    Y=93 OR Y=98 THEN GOTO 870
820 GOTO 900
830 LET Y=Y+16
840 PRINT AT L(Y),C(Y);CHR$(J+165);CHR$(J+37);AT 21,0;
    """LADDER""""LADDER""""LADDER""""LADDER"""
850 PRINT AT L(Y-16),C(Y-16);"LL"
860 GOTO 900
870 LET Y=Y-16
880 PRINT AT L(Y),C(Y);CHR$(J+165);CHR$(J+37);AT 21,0;
    "SSSSSSSSSSSSSSSSSSSSSSSSSSSSSNAKE"
890 PRINT AT L(Y+16),C(Y+16);"SS"
900 LET P(J)=Y
910 RETURN
```

Program 6.

```
330 IF P(J)+X >100 THEN GOTO 390
340 PRINT AT 0,1;"HOME";AT 20,0;P$(J);" WINS.
    WELL DONE ";P$(J)
350 PRINT " CONGRATULATIONSCONGRATULATIONS"
370 CLS
380 GOTO 10
390 PRINT AT 21,8;"YOU NEED A ";CHR$(100-P(J)
    +156)
400 GOTO 480
```

Program 7.

```
610 LET Z=1
630 IF P(J)=0 THEN GOTO 670
640 IF Z/2<>INT(Z/2) THEN PRINT
    AT L(P(J)),C(P(J));CHR$(J+
    37);CHR$(J+165)
650 IF Z/2=INT(Z/2) THEN PRINT
    AT L(P(J)),C(P(J));CHR$(J+
    165);CHR$(J+37)
660 LET Z=Z+1
```

Program 8.

```
EDIT  40 PRINT AT 15,0;"HOW MANY PLAYERS? 1 TO 4"
EDIT  60 IF P<1 OR P>4 THEN GOTO 50
EDIT  70 DIM P$(P+1,6)
EDIT  80 DIM P(P+1)
     150 IF P>1 THEN GOTO 190
     160 LET P$(2)="%ZX81%"
     170 LET P=2
     180 LET P(2)=0
     230 IF P$(J)="%ZX81%" THEN GOTO 270
     260 GOTO 280
     270 LET X=INT(RND*6+1)
```

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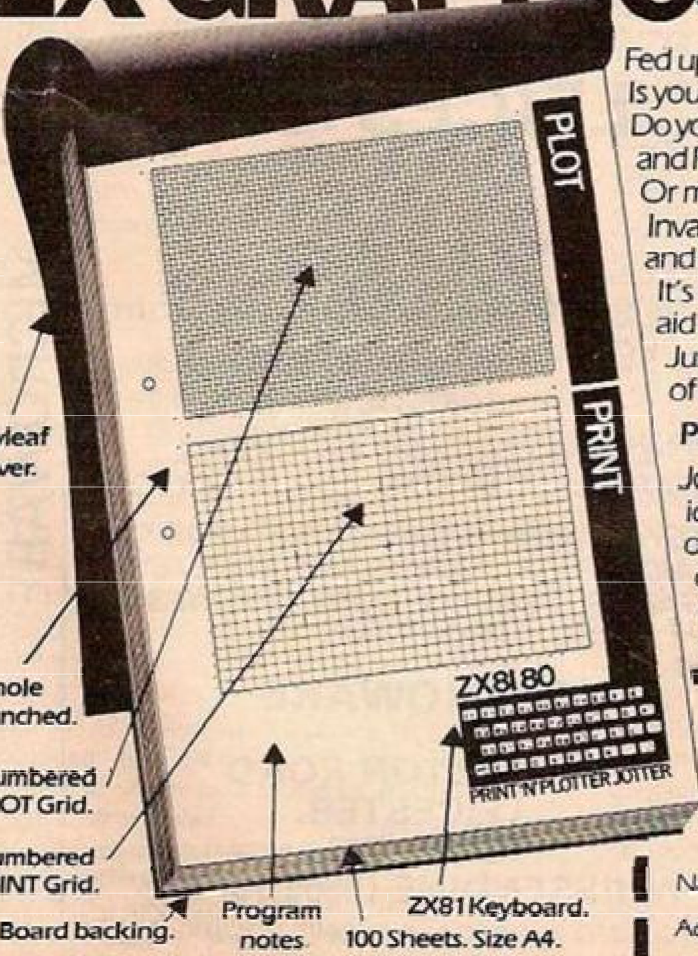
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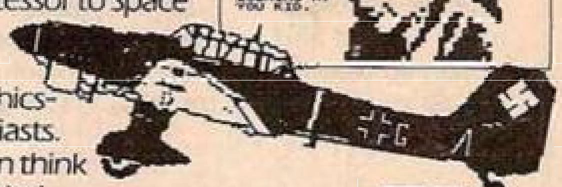
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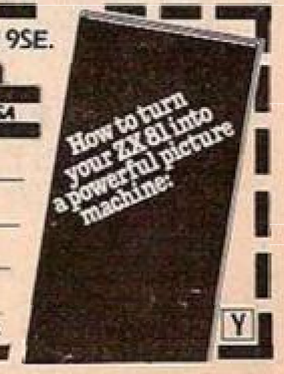
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Points implicated in polar co-ordinate plot

Polar plotting can be instructive and entertaining. Curiously, it receives little attention in education. Bev Mason sets out to correct this anomaly with his Basic program.

GRAPHICAL METHODS which use polar co-ordinates tend to be neglected in schools. This may be due in some degree to the fact that polar co-ordinate graph paper appears to be less readily available than the more familiar Cartesian co-ordinate paper.

Now that computers are becoming relatively common in the classroom, the video screen can be used to show practical examples of polar graphs where previously such plots were roughly indicated and left to the imagination. The curves can now be demonstrated in all their beauty.

Apart from any application in the teaching of mathematics, a program for plotting polars can provide a good deal of amusement. It is mentally stimulating to try and arrive at an equation which will yield a given pattern, and the results can be both attractive and surprising.

Initially, to write a program to plot graphs on the computer screen using the more usual Cartesian co-ordinates can be frustrating. The graph has to be contained within the confines of the screen and this entails calculating scale factors for both x and y, often when the maximum values of one or both variables are not known. Also the positions of the axes have to be determined allowing for possible negative values.

Economical program

These problems are comparatively easy to solve with polar co-ordinates. For most functions all that is necessary is to locate the pole in the centre of the screen, and the single scale factor is readily determined.

The basic program is written in Microsoft Basic originally for a Video Genie. The full list occupies about 0.7K of memory, but a shorter version, using about 0.3K can be employed. This again could be tidied up considerably.

```
 40 CLS
 50 INPUT "ENTER SCALE FACTOR"; C: GOTO80
 60 R=SIN(4*A)
 70 RETURN
 80 INPUT "ENTER INCREMENT OF A"; DA
100 IF DA>0 GOTO 310
110 PRINT "CALCULATING"
120 DA=1: S=0.524: T=-0.005
130 FOR M=0 TO 6.283 STEP S
140 A=M
150 FOR F=0.1 TO 0 STEP T
160 IF F>DA THEN 280
170 GOSUB 60
180 X1=2*C*R*COS(A)
190 Y1=C*R*SIN(A)
200 A=M+F
210 GOSUB 60
220 X2=2*C*R*COS(A): IF X2>63 GOTO 370
230 Y2=C*R*SIN(A): IF Y2>23 GOTO 370
240 DX=ABS(X2-X1)
250 DY=ABS(Y2-Y1)
260 IF DX>1 OR DY>1 THEN 280
270 DA=F
280 NEXT F
290 NEXT M
295 REM DRAW GRAPH
310 CLS: FOR A=0 TO 6.283 STEP DA
320 GOSUB 60
330 X1=R*COS(A): Y1=R*SIN(A)
340 X=64+2*C*X1: Y=24-C*Y1: IF X>127
    OR X<0 OR Y>47 OR Y<0 GOTO 370
350 SET (X,Y):NEXT
360 GOTO 360
370 PRINT "SCALE FACTOR TOO BIG": GOTO 50
380 END
```

Line 50: this enables the scale factor to be entered. It is usually larger than unity. For example, in the case of the expression shown in line 60, a scale factor of unity would result in the whole graph being drawn in a single dot in the middle of the screen.

Line 60: the function to be plotted must be typed here before the program is Run. The function shows the relationship between the radius vector R and the angle A.

Line 80: the smaller the increment of A entered, the closer together will be the points in the design.

Lines 110-290: this section of the program calculates the increment of A necessary to ensure a continuous line in the design for the majority of expressions which will be encountered. If you want to use this facility, the input query in line 80 should be answered by pressing Newline or Enter. The variable DA will then fail the test in line 90 and the program will continue with line 110. As this section takes some time to do its sums, line 110 is included to show that something is happening.

Line 310: this lets the independent variable A vary from 0 to 2π. The Video Genie works in radians, not degrees.

Line 330: although we are plotting in polar co-ordinates, computers work in Cartesian co-ordinates, hence the conversions in this line.

Line 240: this introduces the scale factor and sets the pole at the centre of the screen. The Video Genie plots x from left to right and y from top to bottom — the origin is at the top left-hand corner. The grid is 128 wide by 48 high and the graphic elements are higher than they are

(continued on next page)

(continued from previous page)

wide. All of which means that the X1 values have to be multiplied by 2 to keep the proportions right. The addition of 64 to the X1 values puts zero X1 in the centre of the screen. Similarly, the addition of 24 to the Y1 values puts zero Y1 in the centre, and the negative sign ensures that Y increases upwards in the conventional manner. Line 340 also tests if any point lies off the screen and if so asks for a new scale factor at Line 370.

Line 350: this plots the picture.

Line 360: it keeps the picture on the screen until you hit Break.

For a quick start, omit lines 100 to 295. We now have the basic program. Always return to this before typing the variations that follow. Type

```
60 R=SIN(4*A)
```

and Run. Enter 24 for scale factor C and 0.04 for the increment of A (DA). You should have an eight-petalled rose — see figure 1. If you prefer the dots to be closer, reduce DA. There are no axes in polar graphs, but you can add the polar equivalent by plotting the major grid lines, equivalent to A values of 0.5π, π, 1.5π and 2π. Do this by adding lines

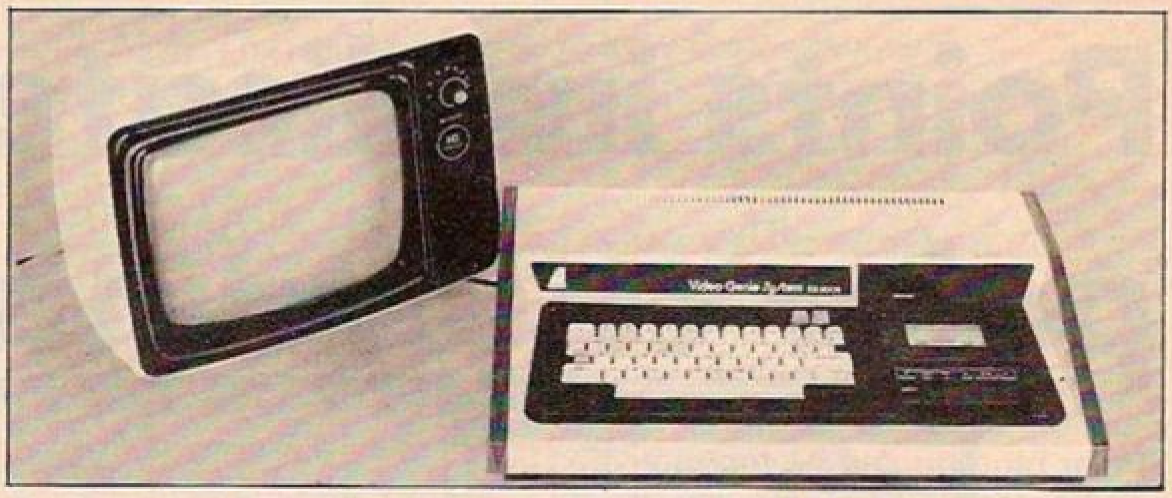
```
296 CLS: FOR X=0 TO 127
297 SET (X,24): NEXT
298 FOR Y=0 TO 47
299 SET (64,Y): NEXT
```

and delete the CLS: from line 310.

It is interesting to see the effect of varying the constant in line 60. Do this by

```
50 delete the GOTO 80
55 INPUT "ENTER CONSTANT K"; K: GOTO80
60 R=SIN(K*A)
```

You will find that as the value of K is increased, it is necessary to reduce DA to maintain a reasonable picture, e.g., try with



C=24, K=9 and DA=0.03 or K=20 and DA=0.01.

For trigonometric functions such as these — do not omit to try cosines — the graphs tend to stay within bounds. For others, it may be necessary to alter the limits in line 310, and in line 130 if used. For example, try the equiangular spiral:

```
60 R=1.2[A
```

In Video Genie language this means 1.2 raised to the power A.

```
310 CLS: FOR A=0 TO 12.56 STEP DA
```

Run with C=2 and DA=0.2

Care must be taken to avoid divisions by zero as could occur with

```
R=V*CSC(A)+W
```

known as the Conchoid of Nicomedes. In Microsoft Basic, this has to be rewritten in the form:

```
60 R=0.5/SIN(A) +2
```

For values of A near zero, π, and 2π, R becomes very large and the range of A must be restricted:

```
310 CLS: FOR A=0.2 TO 2.94 STEP DA
355 FOR A=3.24 TO 6.18 STEP DA: GOTO 320
```

Run with C=6 and DA=0.05.

Then you could try the Limacon:

```
60 R=0.5-COS(A)
```

with C=20 and DA=0.1 or even the Lituus:

```
60 R=SQR(1/A)
```

for A=0.2 to 15.5, C=20 and DA=0.1. For the best effect with this one, alter the constant 64 in line 340 to 30 to move the graph to the left.

The last example illustrates the ease with which the location of the graph can be altered. By changing the constants 64 and 24 in line 340 and reducing the scale, it is possible to place a graph in a corner while the result of the screen is used for another purpose. Alternatively, different graphs could be put in the four corners.

Hearts and flowers

Making the graph move is not easy if we stick to Basic; it is far too slow. However, if the expression is made simple enough, movement is possible e.g., 60 R=12, with the following alterations.

```
310 CLS: FOR A=0 TO 10000 STEP DA
345 RESET(X2,Y2): X2=X: Y2=Y
```

Run with C=1 and DA=0.4.

We have already seen some flowers. The plots of the sine relationships with which we started are known in the trade as roses. Incidentally, a better-shaped rose with overlapping petals can be obtained by changing:

```
305 CLS: S=0.45: FOR B=0 TO 5.85 STEP S
310 FOR A=0 TO 0.7854 STEP DA
330 X1=R*COS(A+B): Y1=R*SIN(A+B)
355 NEXT B
```

Run with C=22 and DA=0.04

We could try something a little more interesting such as, for example, a dahlia. Let us alter our original program once again:

```
50  INPUT "ENTER SCALE FACTORS"; D,E:
    GOTO 80
55  N=0
60  R=SIN(4*A): RETURN
70  R=COS(4*A): RETURN
305 CLS
310 FOR A=0 TO 6.283 STEP DA
315 IF N=1 C=E: GOTO 328
320 C=D: GOSUB 60
324 GOTO 330
328 GOSUB 70
360 N=1: GOTO 310
```

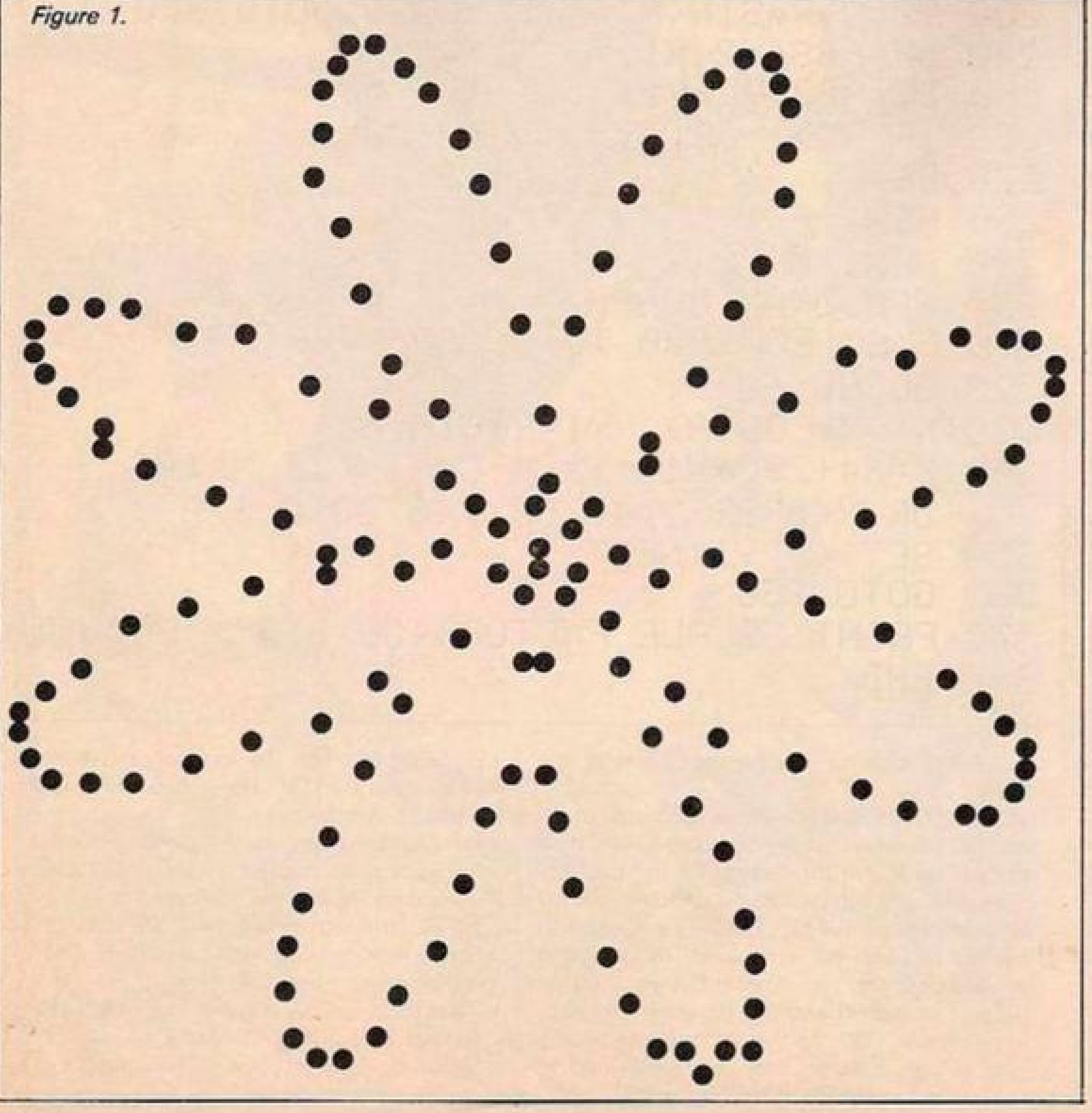
Run and enter scale factors 12,22 and DA 0.02.

What could be better than a cardiod for hearts? Once again, alter the original program:

```
60  R=1-SIN(A)
340 Change the constant 24 to 10
```

Run with C=14 and DA=0.1. ■

Figure 1.



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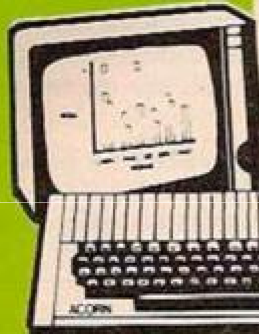


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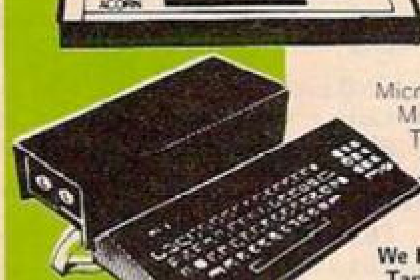
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RS-232
PERIPHERAL INTERFACE

The RS-232 port on the Vic is the machine's main communications route to the outside world. Through this serial I/O port, the Vic can interface with peripherals such as printers and Modems. Nick Hampshire unravels the technicalities.

A SERIAL I/O port can consist of as few as three lines: an output or transmit line, an input or receive line and a common ground line. The data is transmitted or received as a stream of pulses and a single byte becomes a string of eight pulses. The format of such a serial bit stream is shown in figure 1.

Although a serial port may have just three lines, other lines are frequently used to transfer control information. The Vic can receive and generate control signals to implement a full X-line interface as well as the simple three-line one.

Whichever implementation is used, all the lines are connected to I/O port B of VIA # 1 — the same lines used for the user port. Normally an RS-232 interface card will be used to connect between the parallel port and a standard RS-232 connector. The card will also provide buffering and a higher drive voltage.

For communications using the simple three-line mode, an interface card can easily be constructed using two buffer/driver integrated circuits. The RS-232 line normally transmits data using a 12V signal. Providing cables are kept short, however, it will work with a 5V signal. The line connections to the VIA are shown in figure 2, and the standard RS-232 connector is shown in figure 3. The function and pin assignment of each of these lines is shown in table 1.

The implementation of the RS-232 port on the Vic involves the use of software to emulate a hardware device. The hardware is the 6551 Universal Asynchronous Transmitter and Receiver or UART.

The Vic designers originally intended to use this chip to generate the RS-232 I/O. However, MOS was unable to deliver the devices in time for the Vic production, and software emulation had to be employed.

An exact emulation of the function of the 6551 is used since it allows the manufacturer to change the Vic hardware design to incorporate the 6551 as soon as this device becomes available.

Like the other I/O chips, the 6551 functions are controlled by registers at specific memory locations. The pseudo-6551 registers are located in various parts of the variable storage area at the bottom of Vic memory. Besides the registers, the RS-232 operating routines require two 256-byte buffers; one for receive data and the other for transmitted data.

The 512 bytes of memory occupied by these buffers is located at the top of available RAM memory and the starting address of the two buffers is stored in four register bytes. The two most important registers are the control and command. They determine the exact operation of the RS-232 port and can be summarised as follows.

The function of the pseudo-6551 control register — \$0293 hexadecimal, 659 decimal — is to set the speed of data transmission and reception, and stipulate the number of bits needed to transmit each character. The speed at which data is input or output is called the baud rate, and it describes the number of bits transmitted per second.

If the baud rate is set to 300 baud and each character is transmitted at eight character bits plus one stop bit and one parity bit — a total of 10 bits — then 30 characters will be transmitted every second.

The selected baud rate depends on the specifications of the device communicating with the Vic via the RS-232 port. Check the manual of the device before setting this value. Bits 5, 6 and 7 control the number of bits needed to transmit or receive data between the Vic and a peripheral. The number of bits per character plus the number of stop bits depend on the device communicating with the Vic via the RS-232 port.

The pseudo-6551 command register — \$0294 hexadecimal, 660 decimal — controls the mode of data transmission and reception. Bit 0 sets the mode, a three-line mode or a X-line mode. Bit 4 sets the duplex mode as follows:

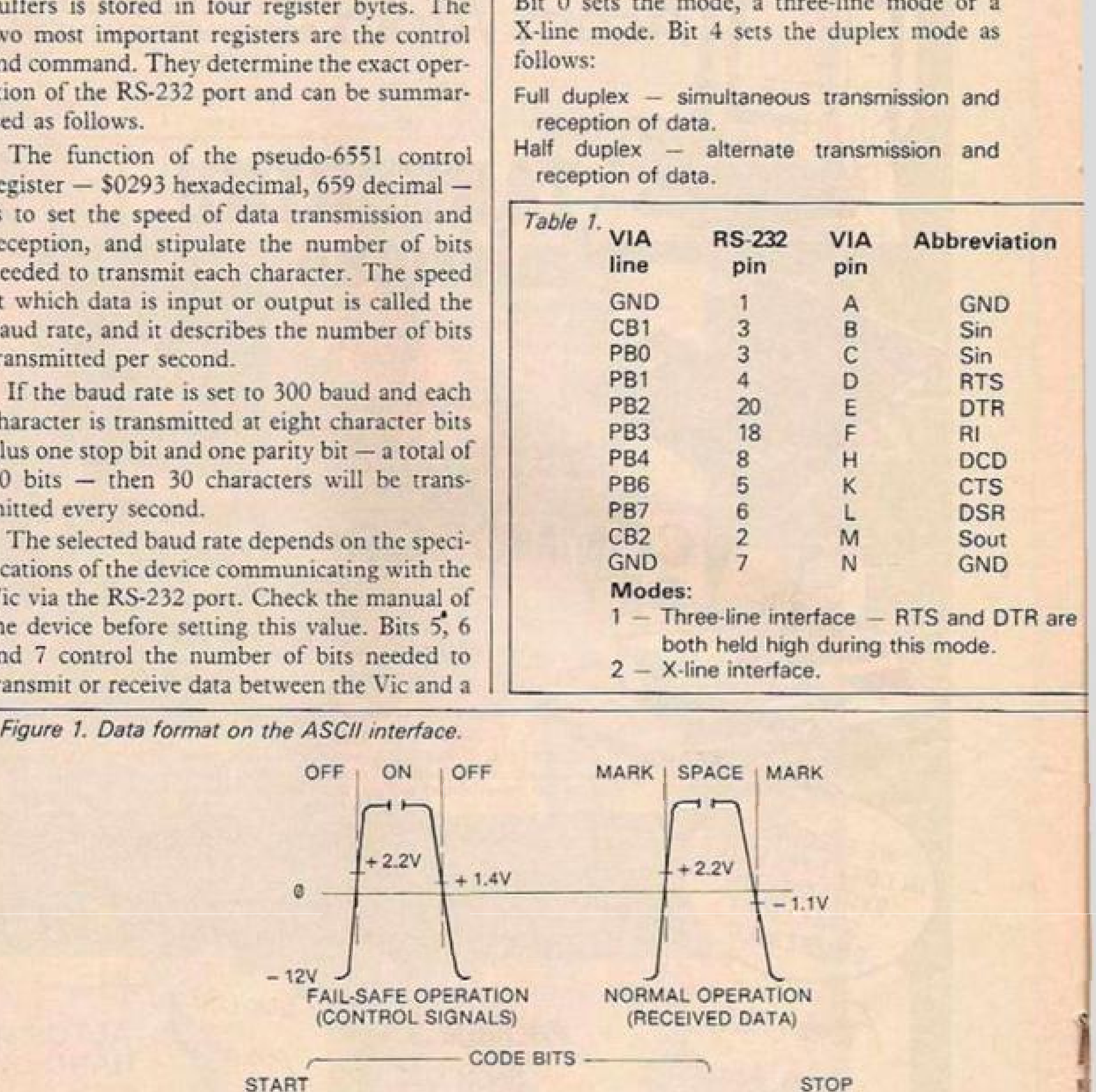
Full duplex — simultaneous transmission and reception of data.
Half duplex — alternate transmission and reception of data.

Table 1.

VIA line	RS-232 pin	VIA pin	Abbreviation
GND	1	A	GND
CB1	3	B	Sin
PB0	3	C	Sin
PB1	4	D	RTS
PB2	20	E	DTR
PB3	18	F	RI
PB4	8	H	DCD
PB6	5	K	CTS
PB7	6	L	DSR
CB2	2	M	Sout
GND	7	N	GND

Modes:
1 — Three-line interface — RTS and DTR are both held high during this mode.
2 — X-line interface.

Figure 1. Data format on the ASCII interface.



OF VIC-20 PORT

Bits 5, 6 and 7 determine the nature of the parity bit and whether the mark or space is transmitted. The parity bit is transmitted after the data bits and has an error-checking function.

The choice of whether the parity is disabled or is set to odd or even depends on the specification of the communicating device attached to the Vic RS-232 port. The mark/space setting determines whether a logic 1 is transmitted as a zero voltage or a positive voltage. This is shown in figure 1.

The RS-232 status register is $0297 hexadecimal, 663 decimal. The other memory locations and pseudo-6551 registers are as follows:

$A7 — receiver input-bit temporary storage
$A8 — receiver bit count in
$A9 — receiver flag start-bit check
$AA — receiver byte buffer or assembly location
$AB — receiver parity-bit storage
$B4 — transmitter bit count out
$B5 — transmitter next bit to be sent
$B6 — transmitter byte buffer/disassembly location
$F7-$F8 — a two-byte pointer to the receiver buffer-base location
$F9-$FA — a two-byte pointer to the transmitter buffer-base location
$0298 — the number of bits to be sent or received
$0299-$029A — the time for transmission of one bit cell based on system clock or baud rate
$029B — the byte index to the end of the receiver FIFO buffer
$029C — the byte index to the start of the receiver FIFO buffer
$029D — the byte index to the start of the transmitter FIFO buffer
$029E — the byte index to the end of the transmitter FIFO buffer

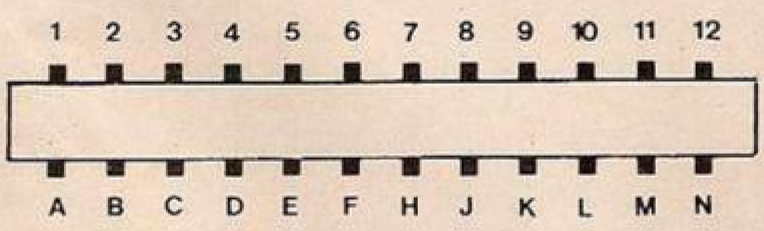
EIA	In/ Out	Modes	Function
AA	—	1,2	Protective ground
BB	In	1,2	Received data
BB	In	1,2	Connected to Sin
CA	Out	2	Request to send
CD	Out	2	Data terminal ready
CE	In	3	Ring indicator
CF	In	2	Received line signal
CB	In	2	Clear to send
CC	In	2	Data set ready
BA	Out	1,2	Transmitted data
AB	—	2,3	Signal ground

3 — User available only and not implemented or used in the Vic RS-232 code.

Here are the RS-232 system-routine entry points:

$EFA3 — entry for NMI-continue routine
$EFBF — calculate parity, $B5 = 0 upon entry
$EFE8 — count stop bits
$EFEE — entry to start of byte transmission
$EFFB — set up to send next byte
$F016 — set errors
$F027 — calculate number of bits to be sent, returns number of bits + 1
$F036 — NMI routine to collect data into bytes
$F040 — calculate parity
$F046 — shift data bit in
$F04B — have stop bit so store in buffer
$F05B — enable to receive a byte
$F068 — receiver start bit check
$F06F — put data in buffer at parity times
$F08B — parity checking
$F094 — check calculated parity
$F09F — errors reported
$F0BC — output a file over user port using RS-232
$F0C4 — check for DSR and RTS
$F0CD — check for active input; RTS will be low if currently inputting
$F0D4 — wait for CTS to be off
$F0D9 — turn on RTS
$F0E1 — wait for CTS to go on
$F0ED — buffer handler to output a character
$F0FC — set up if necessary to output
$F102 — set up for a first byte out
$F10E — set up for T1 NMIs
$F116 — input a file over user port using RS-232
$F122 — check if DSR and not RTS
$F12B — wait for active output to be done
$F130 — turn off RTS
$F138 — wait for DCD to go high
$F13F — enable CB1 for RS-232 input
$F146 — if not three-line half, then see if we need to turn on CB1
$F14F — input a character buffer handler
$F15C — receiver always runs
$F160 — protect serial/cassette from RS-232 NMIs

Figure 2. User I/O.



PIN #	TYPE	NOTE	PIN #	TYPE	NOTE
1	GND		A	GND	
2	+5V	100mA MAX.	B	CB1	
3	RESET		C	PB0	Sin
4	JOY0		D	PB1	RTS
5	JOY1		E	PB2	DTR
6	JOY2		F	PB3	RI
7	LIGHT PEN		H	PB4	DCD
8	CASSETTE SWITCH		J	PB5	
9	SERIAL ATN IN		K	PB6	CTS
10	9VAC		L	PB7	DSR
11	9VAC		M	CB2	Sout
12	GND		N	GND	



PIN		TalCo	CCITT
1	Protective Ground	AA	101
2	Transmitted Data	BA	103
3	Received Data	BB	104
4	Request to Send	CA	105
5	Clear to Send	CA	105
6	Data Set Ready	CC	107
7	Signal Ground	AB	102
8	Carrier Detect	CF	109
9	(not used)		
10	(not used)		
11	(not used)		
12	(not used)		
13	(not used)		
14	(not used)		
15	(not used)		
16	(not used)		
17	(not used)		
18	(not used)		
19	(not used)		
20	Data Terminal Ready	CD	108
21	(not used)		
22	(not used)		
23	(not used)		
24	(not used)		
25	(not used)		

Figure 3. Serial I/O cable connector pins.

The Basic syntax for opening an RS-232 channel is:

OPEN # lf, 2, 0, "<control register> <command register>"

lf is the normal logical file ID — 1 to 255. If lf is less than 127 then line feed follows carriage return. <control register> is an ASCII character equivalent to the required bit setting of the control register. For example, to set baud rate to 300 and transmit seven-bit code, use CHR$(6+32). This sets bits 1,2 and 5 to logic 1 and leaves the rest at logic 0.

<command register> is an ASCII character equivalent to the required bit setting of the command register. For example, to set the output to mark parity and full duplex, use CHR$(32+128). This sets bits 5 and 7 to logic 1 and leaves the rest at logic 0.

The machine-code entry point is $FFC0 hexadecimal. Only one RS-232 channel should

(continued on next page)

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be open at any time. The Open statement resets the buffer pointers, so a second Open will destroy any data in the buffers set up in the first Open.

The Open RS-232 channel command should be used before any variable or Dim statements. Failure to do this will mean the data is wiped. This is because the Open RS-232 channel command performs an automatic CLR before allocating the 512 bytes at the top of memory used for the two RS-232 data buffers.

If there is insufficient space at the top of memory for the 512-byte buffer, the program will be destroyed. The file-name field in the Open command statement can have up to four characters, only two characters are currently used by the system. The other two characters are for future systems options.

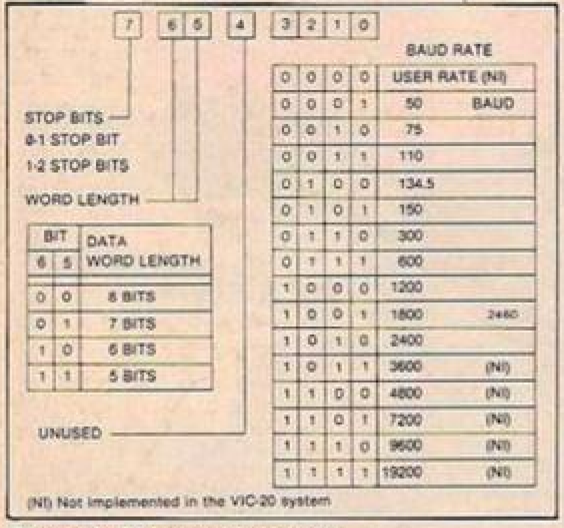
No error-checking is performed by the system on the contents of the control or command characters and errors in baud-rate selection will cause system malfunction. A non-implemented baud rate will cause an index to bad-page data, and output will be set to a rate below 50 baud.

To receive data from an RS-232 channel, use the Basic syntax

GET # lf, <string variable>

lf represents the logical file ID used in the Open RS-232 channel command.

The machine-code Entry Points are $FFC6 which means open channel for input. It



BIT 6	BIT 5	DATA WORD LENGTH
0	0	8 BITS
0	1	7 BITS
1	0	6 BITS
1	1	5 BITS

3	2	1	0	BAUD RATE	
0	0	0	0	USER RATE (NI)	
0	0	0	1	50	BAUD
0	0	1	0	75	
0	0	1	1	110	
0	1	0	0	134.5	
0	1	0	1	150	
0	1	1	0	300	
0	1	1	1	600	
1	0	0	0	1200	
1	0	0	1	1800	2400
1	0	1	0	2400	
1	0	1	1	3600	(NI)
1	1	0	0	4800	(NI)
1	1	0	1	7200	(NI)
1	1	1	0	9600	(NI)
1	1	1	1	19200	(NI)

Figure 4. The control register.

handles the full X-line implementation according to EIA standard RS-232C interfaces. The RTS, CTS and DCD lines are implemented when the Vic is designated as a data terminal device. $FFE4 means take a character from the buffer.

Received data is put into the Vic's 255-byte internal receiver buffer set up during the Open RS-232 channel command. Data input is under the control of the 6522 timers and interrupts, and is performed in the background when a Basic program is run.

This is done by having the RS-232 data-input line connected to the CB1 handshake line. An input on CB1 will generate an NMI system interrupt. The use of NMI interrupts is the reason why the cassette and serial bus should not be used during RS-232 data communications.

The NMI interrupt will call the serial data-input routines whenever data is present on the RS-232 input. These routines place the

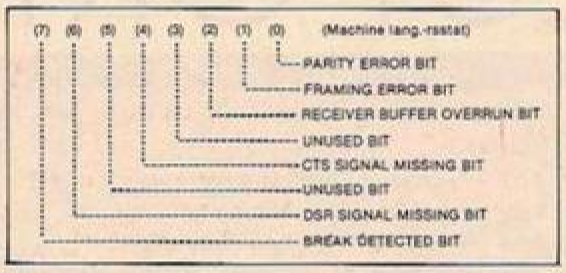


Figure 5. RS-232 status register.

received data into the 255-byte receiver buffer located at the top of RAM memory. If the input data has a word width less than eight bits, then all unused bits will be filled with zero.

The receiver buffer is organised as a first-in first-out — FIFO — buffer. The buffer removes the necessity for Basic to wait for data input before processing each byte of data. Instead, the Basic program can take data from the buffer when it needs it, rather than when it is presented.

Basic accesses the buffer, using the Get command to transfer a single byte of data into a Basic variable. If there is no data in the buffer, then the Get# command will return with a null character. If the buffer should overflow, all characters received during the overflow condition are lost, an overflow condition is indicated by bit 2 in the RS-232 status register being set.

Overflow will frequently occur, if an attempt is made to input data at relatively high data rates using Basic. This is because Basic is normally slow, and the use of the Get command with string concatenation will result in garbage. Machine-language routines are best used for data rates above the normal 300 baud.

To transmit data to an RS-232 channel, use the Basic syntax:

CMD lf
PRINT # lf + <variable list>

lf is the logical file ID, set up in the Open RS-232 channel command. The machine-code entry points are $FFC9 which means open channel for output. This handles X-line handshaking for the implementation of an EIA standard RS-232 interface. The RIS, CTS, and DCD lines are implemented with the Vic as a data terminal. $FFD2 means output character to channel.

When either one of the two Basic commands are used, data is first transferred from the assigned string or memory block to the 255-byte transmitter buffer. From here, it is output to the RS-232 channel using the format and baud rate assigned in the Open RS-232 channel command.

Data output is transparent to the operation of Basic since the timing is done by the 6522 timers and output of each byte initiated by an NMI system interrupt.

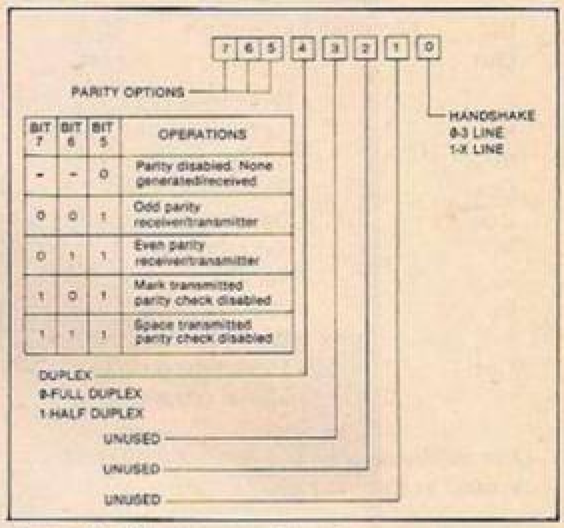
As with data input on the RS-232, the cassette or serial IEEE port should not be used during data transmission. If it is, interrupt conflicts will occur. No carriage-return delay is implemented by the output channel. Therefore, a normal RS-232 printer cannot correctly output the data, unless some form of internal buffering is implemented by the printer.

If a CTS handshake is implemented — in the X-line mode — then the Vic buffer will fill, and output will not occur until transmission is allowed by an input on CTS.

To close an RS-232 data channel, use the Basic syntax:

CLOSE lf

lf is the logical file ID set-up in the Open RS-232 channel command. The machine-code



BIT 7	BIT 6	BIT 5	OPERATIONS
-	-	0	Parity disabled. None generated/received
0	0	1	Odd parity receiver/transmitter
0	1	1	Even parity receiver/transmitter
1	0	1	Mark transmitted parity check disabled
1	1	1	Space transmitted parity check disabled

Figure 6. The command register.

Entry Point is $FFC3, which means close the logical file.

Closing the RS-232 file causes all the data in the buffers to be discarded. It stops data transmission or reception, sets the RTS and Sout lines high, and de-allocates the memory area used for the RS-232 buffers. Closing the RS-232 file will also allow the cassette or serial IEEE ports to be used.

Before closing the channel, care should be taken to ensure that all data in the buffer is transmitted. This can be done by checking the status — the ST variable is equal to 0 — and that bit 6 of parallel port A of VIA # 1 location 37151 is set to logic 1. If both are true then there is still data in the buffer. ■

A sample Basic program.

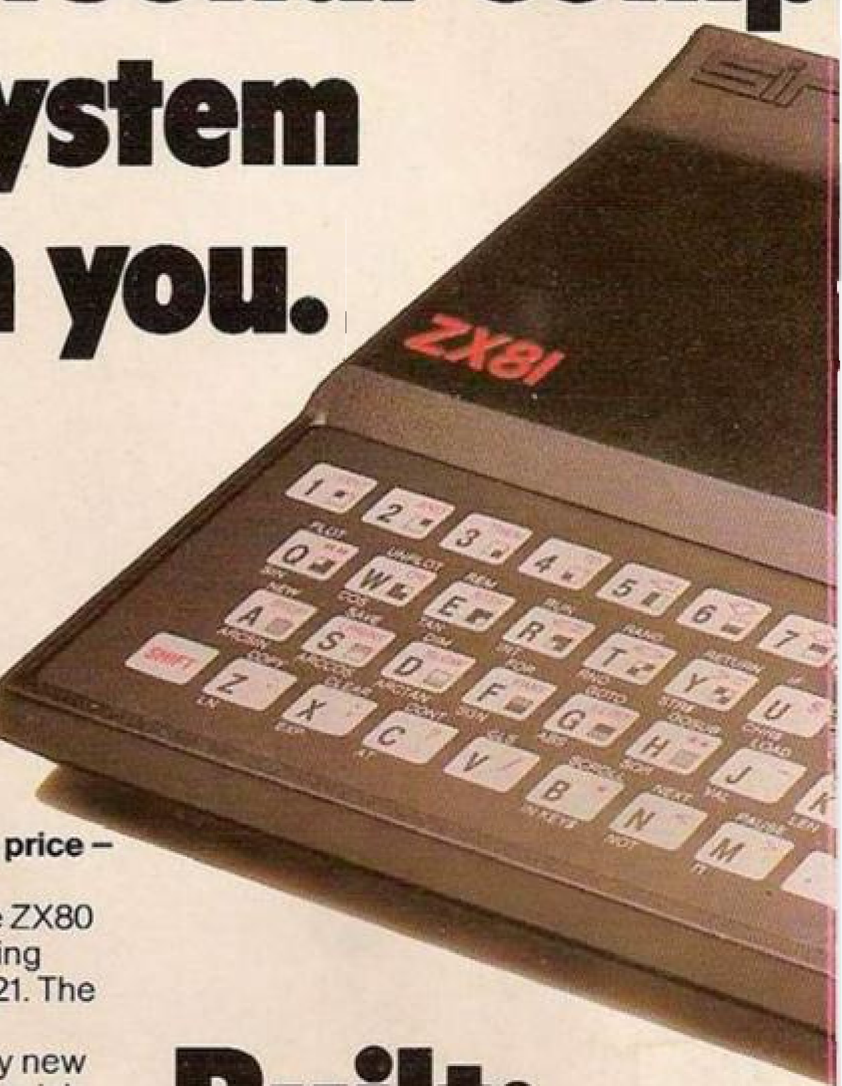
```
  RS232 SERIAL COMMUNICATIONS
  5 SAMPLE BASIC PROGRAM (BY PERMISSION OF CBM)
 10 REM THIS PROGRAM SENDS AND RECEIVES DATA TO/FROM
    A SILENT 700 TERMINAL
 20 REM TI SILENT 700 SET-UP: 300 BAUD, 7-BIT ASCII,
    MARK PARITY, FULL DUPLEX
 30 REM SAME SET-UP AT COMPUTER USING 3-LINE INTERFACE
100 OPEN 2,2,3,CHR$(6+32)+CHR$(32+128): REM OPEN THE
    CHANNEL
110 GET#2,A$: REM TURN ON THE RECEIVER CHANNEL (TOSS
    A NULL)
200 REM MAIN LOOP
210 GET B$: REM GET FROM COMPUTER KEYBOARD
220 IF B$<>"" THEN PRINT#2,B$;: REM IF A KEY PRESSED,
    SEND TO TERMINAL
230 GET#2,C$: REM GET A KEY FROM THE TERMINAL
240 PRINT B$;C$;: REM PRINT ALL INPUTS TO THE
    COMPUTER SCREEN
250 SR=ST: IF SR=0 THEN 200: REM CHECK STATUS, IF
    GOOD THEN CONTINUE
300 REM ERROR REPORTING
310 PRINT "ERROR: ";
320 IF SR AND 1 THEN PRINT "PARITY"
330 IF SR AND 2 THEN PRINT "FRAME"
340 IF SR AND 4 THEN PRINT "RECEIVER BUFFER FULL"
350 IF SR AND 128 THEN PRINT "BREAK"
360 IF (PEEK(37151) AND 64)=1 THEN 360: REM WAIT
    UNTIL ALL CHARS TRANSMITTED
370 CLOSE 2: END
```

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ZX81

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How the ZX81 compares with other personal computers

SYSTEM IDENTIFICATION		ZX81	ZX80	ACORN ATOM	APPLE II PLUS	PET 2001	TRS 80 LEVEL I	TRS 80 LEVEL II
ROM		8K	4K	8K	8K	14K	4K	12K
GUIDE PRICE	Basic unit – inc. VAT Unit plus 16K RAM (*12K RAM)	£70 £120	£100 £150	£175 £285*	£630 £630	£435 £530	£290 £360	£375 £375
COMMANDS	LIST, LOAD, NEW, RUN, SAVE	●	●	●	●	●	●	●
STATEMENTS	PRINT, INPUT, LET, GOTO, GOSUB/RETURN, FOR/NEXT IF/THEN	●	●	●	●	●	●	●
	STEP	●		●	●	●	●	●
	TAB	●			●	●	●	●
ARITHMETIC	ABS, RND	●	●	●	●	●	●	●
FUNCTIONS	INT	●			●	●	●	●
	ATN, COS, EXP, LOG, SGN, SIN, SQR, TAN	●			●	●		●
	ARCSIN, ARCOS	●						
STRING	CHR$	●	●		●	●		●
FUNCTIONS	LEN	●		●	●	●		●
	ASC(CODE), STR$, VAL, INKEY$	●				●		●
NUMBERS	FLOATING PT $\pm10^{38}$	●			●	●	●	●
	INTEGERS		●	●	●	●		●
NUMERIC	A-Z			●			●	
VARIABLES	AA-ZØ				●	●		●
	An-Zn, n = any alphanumeric string	●	●					
STRING	A$ & B$						●	
VARIABLES	A$ to Z$	●	●	●				
	An$ to Zn$ n = any alphanumeric character				●	●		●
NUMERIC	SINGLE DIMENSIONAL		●	●			●	
ARRAYS	MULTI DIMENSIONAL	●			●	●		●
DISPLAY	ROWS	24	24	16	24	25	16	16
	COLUMNS	32	32	32	40	40	64	64
	LOW RES GRAPHICS (<7000 pixels)	●	●	●	●	●	●	●
	HI RES GRAPHICS (>40000 pixels)			●	●			
SPECIAL	USR (CALL, LINK)	●	●	●	●	●		●
FEATURES	PEEK, POKE (OR EQUIV)	●	●	●	●	●		●

Sinclair software on cassette.



The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

Sinclair has undertaken to publish the most elegant of these on pre-recorded cassettes. Each program is carefully vetted for interest and quality, and then grouped with others to form single-subject cassettes.

Software currently available includes games, junior education, and business/household management systems. You'll receive a Sinclair ZX Software catalogue with your ZX81 – or see our separate advertisement in this magazine.

The ultimate course in ZX81 BASIC programming.



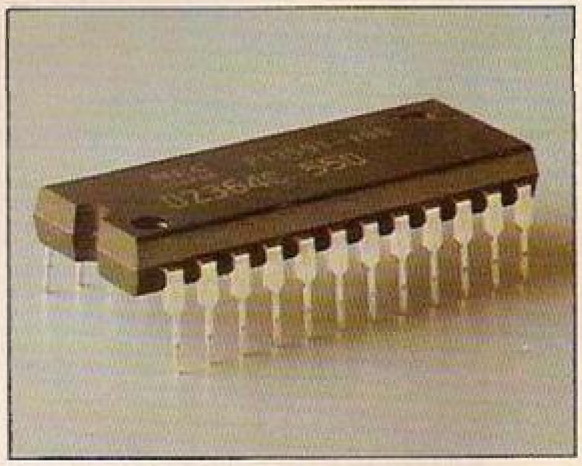
Some people prefer to learn their programming from books. For them, the ZX81 BASIC manual is ideal.

But many have expressed a preference to learn *on* the machine, *through* the machine. Hence the new cassette-based ZX81 Learning Lab.

The package comprises a 160-page manual and 8 cassettes. 20 programs, each demonstrating a particular aspect of ZX81 programming, are spread over 6 of the cassettes. The other two are blank practice cassettes.

Full details with your Sinclair ZX81.

If you own a Sinclair ZX80...



The new 8K BASIC ROM used in the Sinclair ZX81 is available to ZX80 owners as a drop-in replacement chip. (Complete with new keyboard template and operating manual.)

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ZX81

**6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Tel: (0276) 66104 & 21282.**

With this complete noughts and crosses program, Boris Allan puts into practice the logical and strategic processes discussed last month.

NOUGHTS AND CROSSES, or tic-tac-toe, is a game which is older than at least some of the hills. It is a game of symmetries, and regularities, and so should eminently suit a programmable solution. There seems to be a common fault with novice programmers: in attempting to make the program as physcially short as possible, they often ignore the run-time efficiency or give it too low a priority.

A little thought about the structure of the problem can improve the final structure of a program. I am not advocating structured programming or anything so esoteric, and I am not suggesting any rules to be followed which will produce perfect bug-free programs — partly because such rules do not exist — but I am suggesting some prior thought.

The program is written in Atom Basic, because it is a small computer to hand, with excellent graphics. In any case, when the design of the program is discussed the language, and the computer, are not important. Thinking about the problem, noting certain key points, I made some written elaborations of what the points implied about the structure of the problem.

Two people play the game. Since one person is X and the other is O, why not let O be given the internal code 1 and X the code -1? The ASCII value for the character 0 is 79, and for X it is 88. So, if the code is P the correct character is given by the ASCII value

(9*(1-P)/2 + 79)

That is, if P = +1 then the value is 79, and if P = -1 then the value is 88. In one program I have seen, there are statements of the form

```
1000 IF P=1 THEN C$ = "O"
1010 IF P=-1 THEN C$ = "X"
```

or

```
2000 IF P=1 GOTO 2030
2010 PRINT "X"
2020 GOTO 2040
2030 PRINT "O"
2040 REM +CONTINUE+
```

and those I have labelled 1000 onwards are redundant, whereas the lines 2000 onwards could all be compressed to the one line written in a special variant of Basic:

```
2000 PRINT CHARACTER(9*(1-P)/2 + 79)
```

It would seem sensible to choose the person who is to start by random methods — though the players could choose.

The board has nine elements, and it would be reasonable to label the cells in some regular way. If R is the row number — 0,1,2 — and C is the column number — 0,1,2 — then the board could be described as in figure 1 where the first number is the row, and the second number is the column. In any program this regularity should be utilised as far as possible.

It is clear that the same square cannot be used twice: the squares need to be set at the start to a blank value, say, zero internally in the program. A check needs to be made to see if an entry has already been made in the square chosen by the player. If the square is not blank, the user has to re-enter a value. If the square is blank, an O or X can then be entered 1 or -1, internally.

The board needs to be sent to the output device, either as text or by use of graphics. Again the regularity of the board is important in this.

No lines need to be checked until five squares have been entered, and only lines through the last square need to be checked. This highly important way of decreasing the amount of work to be done was ignored in the program I examined. For each entry or move all eight lines on the board were checked — that is, three horizontal, three vertical, and two diagonal. For example: in cell 0,1 only row 0 and column 1 need be checked; whereas for cell 2,0 row 2, column 0, and the forward diagonal — 2,0 to 0,2 — need to be checked.

Only one marker is needed, i.e., P : P will be either +1 or -1 — for O or X — on each turn, so somewhere we will need to write P=-P to change sign. There is no need to keep 0 or X in any stored location, because we can use the information that the ASCII code is

(9*(1-P)/2 + 79)

The value of P to start can be set by a random number generator. Either the board can be represented internally by a one-dimensional array of nine elements — ranging from 0 to 8 — or it can be represented as a two-dimensional array of nine elements, ranging from 0 to 2 by 0 to 2.

If a one-dimensional array is used: the row R, corresponding to element number E is given by

R = TRUNC(E/3)

That is, E divided by 3 ignoring the remainder. The column, C, is given by

C = E MODULO 3

That is, the remainder when E is divided by 3.

All elements of whatever array is chosen

(continued on next page)

FROM GAMES STRATEGY INTO ACTION

```
   1 REM XOX
   2 REM
   3 REM A PROGRAM FOR THE ATOM
   4 REM
   5 REM BY
   6 REM G J BORIS ALLAN
   7 REM
   8 REM
1000 REM INITIALISATION
1010 DIM BB(8);FOR I=0 TO 8;BB(I)=0;
     NEXT I
1020 P=RND%2;IF P=0 GOTO1020; REM I
     DO NOT USE ATOM LABELS
1030 CLEAR0;PRINT $30''"XOX PROGRAM"
     ''"RANDOM START"'''
1040 PRINT $(9*(1-P)/2+79)" STARTS"
     '''';REM '$' GIVES CHARACTER
1050 INPUT"READY "$I
1060 GOSUB 10000;REM SET-UP BOARD
1500 FOR I=1 TO 9;REM LOOP
2000 REM INPUT
2010 PRINT $7$21;INPUT D;PRINT $6;
     REM BUZZ, ACCEPT CO-ORDINATE
2020 D=D-1;IF D<0 OR D>8 GOTO 2010;
     REM 'D' IN LEGAL RANGE ?
```

(listing continued on next page)

(continued from previous page)

must be set to zero. On input of the co-ordinate of a cell, a check has to be made to ensure that the co-ordinate is within the correct range. Then, if the co-ordinate is admissible, a check has to be made that the cell has not been used before. If all is correct, then the value of P is entered into the correct cell.

I made a decision to use graphics for output of the play, and noted that the graphics output could be split into two parts. First, drawing the board, and, second, displaying the Os and Xs. The first part is trivial. In the second part there are the two basic shapes, O and X, so it would be sensible to define these two shapes, and then the symmetry of the board could be used to place them in the appropriate positions. Take a graphics command

DRAW FROM 0,0 TO 2,2

in some programming language, and the result will be a short diagonal line starting at the origin. The instruction

DRAW FROM (X+0),(Y+0) TO (X+2),(Y+2)

will produce a short diagonal line — parallel to the first — starting in this case at the point X,Y. The values of X and Y in the second Draw instruction are offsets — that is, they indicate where the shape is placed relative to the origin. In graphics routines for O and X, the incorporation of off-sets will mean that these shapes can easily be drawn at any position. The regularity of the board helps here.

For row R and column C, the cell for a two-dimensional array will be isolated by the indices R,C, and for a one-dimensional array the single index 3*R + C will isolate the correct cell. The checks are then simple to arrange.

All the cells for row R are given by the indexes R,0 and R,1 and R,2 for a two-dimensional array. The cells for column C are 0,C and 1,C and 2,C — with equivalents for one-dimensional arrays.

A cell on the forward diagonal is 2,0 and 1,1 or 0,2, so if R+C=2 for the last cell to be entered, then the forward diagonal needs checking. For the backward diagonal 0,0 and 1,1 or 2,2, so R=C for this diagonal to be checked. The diagonals need not be checked if

0 0 Cell 0	0 1 Cell 1	0 2 Cell 2
1 0 Cell 3	1 1 Cell 4	1 2 Cell 5
2 0 Cell 6	2 1 Cell 7	2 2 Cell 8

Figure 1.

R+C is odd, that is, 0,1 and 1,0 and 1,2 or 2,1.

The sequence of control in noughts and crosses can be shown as

1 INITIALISATION
1.5 LOOP — up to nine times
2 INPUT
3 DISPLAY
4 WINNER CHECK — if win exit to (5.1)
4.5 ENDLOOP
5 DRAW and end
5.1 WIN and end

In section 1 an array is dimensioned, and all elements are set to zero. A decision is then made on who is to start and the blank board is drawn. Section 2 allows a move to be entered, and if the move is illegal asks for new input. The move is displayed on the output device — section 3 — before a check is made for a winning line in section 4. There are three possible outcomes, no win and board full — a draw — no win and board not full — next input — or a win and exit from loop.

The modularity of this outline, together with the description of the algorithm, should assure its easy implementation on various machines, and the example I use is the Acorn Atom. Once the program has been written, it is possible to optimise by all kinds of criteria, but no such attempt has been made with the example program.

All this shows how a little thought can achieve greater gains in efficiency than mere space cramming: the best way of having an effective program is by having an effective, well thought out structure — strive for simplicity and efficiency will follow.

Noughts and crosses has been used as an example of how it is possible to design a program in a systematic way, but as it is possible to answer even simple questions in different ways, here is a different answer. Suppose we draw a Magic Square

2	7	6
9	5	1
4	3	8

in which all lines total to 15. To check for a win, all we need do is find whether — for the latest move — any combination of three scores total to 15, always including the score for the latest move.

Each player has up to five possible moves, and so a five-element array will be needed for each person — as will an array to hold the Magic Square. A simple checking procedure might be

```
WIN = 0
CRITERION = 15 - A(MOVE)
FOR J = 2 TO MOVE - 1
SUBCRITERION = CRITERION - A(J)
FOR K = 1 TO J - 1
IF A(K) = SUBCRITERION THEN WIN = 1
NEXT K
NEXT J
REMARK IF WIN IS 1 THEN THERE IS A WIN
```

(listing continued from previous page)

```
 2030 IF BB(D)<>0 GOTO 2010;REM IS
      CELL EMPTY ?
 2040 R=D/3;C=D%3;BB(D)=P;REM 'R' IS
      ROW, 'C' IS COLUMN
 3000 REM DISPLAY
 3010 GOSUB 11000;REM GRAPHICS SHAPE
      ROUTINE
 3020 FOR J=1 TO 60;WAIT;NEXT J;
      REM LET THEM SEE IT
 4000 REM WINNER CHECK
 4010 P=-P; IF I<5 GOTO 4500;REM
      DON'T BOTHER LESS THAN 5
 4020 IF BB(R*3)+BB(R*3+1)+BB(R*3+2)
      =-P*3 GOTO 5100;REM ROW CHECK
 4030 IF BB(C)+BB(C+3)+BB(C+6)=-P*3
      GOTO 5100;REM COLUMN CHECK
 4040 IF (R+C)%2=1 GOTO 4500;REM NOT
      ON DIAGONAL
 4050 IF R+C<>2 GOTO 4080;REM NOT ON
      FORWARD DIAGONAL
 4060 IF BB(2)+BB(4)+BB(6)=-P*3 GOTO
      5100
 4070 IF R<>C GOTO 4500;REM NOT ON
      BACKWARD DIAGONAL
 4080 IF BB(0)+BB(4)+BB(8) GOTO 5100
 4500 NEXT I;REM ENDLOOP
 5000 REM DRAW
 5010 CLEAR0;PRINT $6$30''"GAME IS
      DRAWN"''';END
 5100 REM WIN (FOR-P)
 5110 CLEAR0;PRINT $7$7$7$7'''
      $(9*(1+P)/2+79)" WINS"$7''''''''
 5120 END
10000 REM DRAWS 'BOARD'
10010 CLEAR0
10020 MOVE16,0;DRAW16,48;MOVE32,0;
      DRAW32,48;REM VERTICAL LINES
10030 MOVE0,16;DRAW48,16;MOVE0,32;
      DRAW48,32;REM HORIZONTAL LINES
10040 RETURN
11000 REM DRAWS SHAPES (48X48 BOARD)
11010 X=C*16+8;Y=40-R*16;IF P=-1 GOTO
      11040;REM WHICH SHAPE ?
11020 MOVE(X+5),(Y+5);DRAW(X-5),Y;
      DRAWX,(Y-5);DRAW(X+5),Y
11030 DRAWX,(Y+5);RETURN;REM '0' SHAPE
11040 MOVE(X+5),(Y+5);DRAW(X-5),(Y-5)
11050 MOVE(X+5),(Y-5);DRAW(X-5),(Y+5);
      RETURN;REM 'X' SHAPE
```

■

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PROJECT

FIRST-CHOICE FORTH

John Dawson turns his attention to Microtanic's implementation of Forth and finds that it has all the qualities required for writing process-control software.

FORTH IS compact, versatile and extensible. By using reverse-Polish notation and a stack for holding numbers in the correct order for processing, it is possible to achieve remarkable results using only a few kilobytes of RAM.

It is a high-level language with immediate access to an assembler for sections of a program that are time-critical. In the way it makes you approach problems, it could even be called a software-design "philosophy".

Forth begins with a set of words or commands and then provides the mechanism by which you can define your own words, adding these to the commands already in the language to increase the size of the dictionary. The process of building a definition from a number of previously-defined commands is programming in Forth.

For example, a word-processing program would consist at the top of a single command

```
WORDPROCESSOR
```

This is a definition consisting of other definitions such as Print, Write, Store and Append. Each of the definitions within write consists of lower level commands such as:

```
: SPACE LINECOUNT @ IF SPACE
    1 LINECOUNT +! THEN ;
```

which looks at the position identified by Linecount and adds one to Linecount if the character is a space. Eventually, at the lowest level, definitions are composed of sections of machine code. Space is an example of a colon definition, which tells Forth to remember Space and execute the commands within the definition when it is called.

Some words can be used directly by typing the name at the keyboard — Con, for example, in Listing 1. Others may only be used in the course of defining a word, e.g., Do-Loop or Begin-While-Repeat.

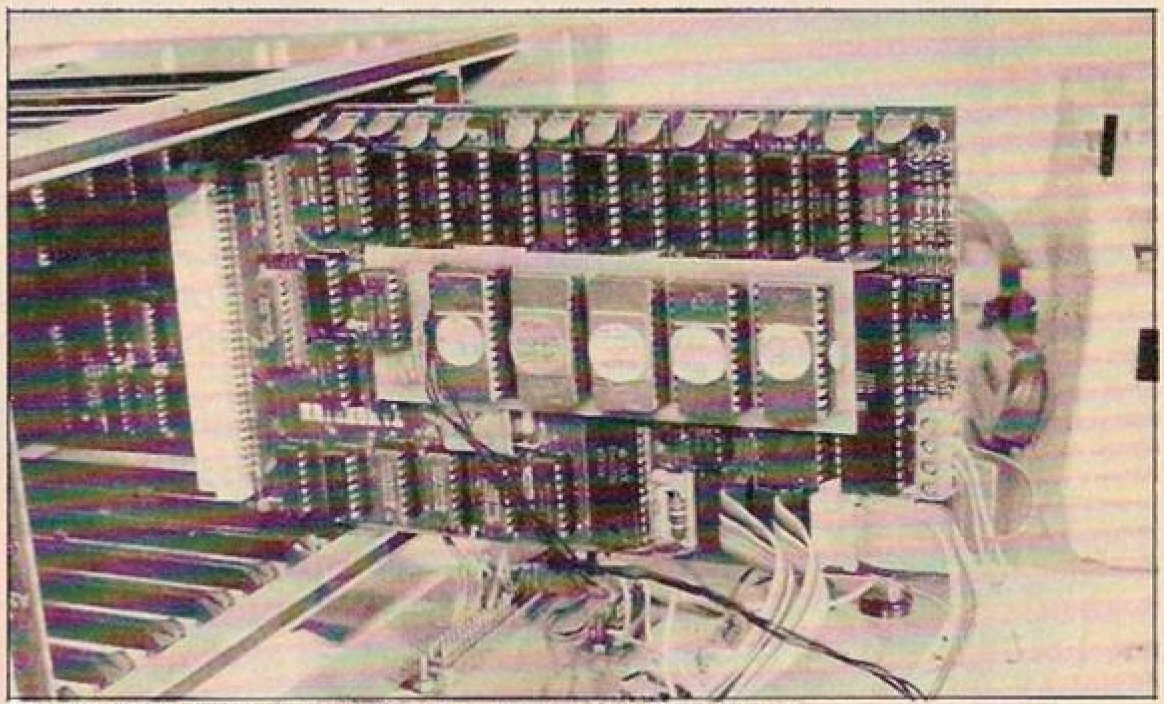
The Forth implementation by Microtanic Software is available either on cassette or in two EPROM chips and is supplied with about 60 pages of documentation. It is the documentation that is the critical part of any package and this Forth system is no exception.

Listing 1.

```
: CON 32-5*9/ . ; OK

99 CON 37 OK

-10 CON -23 OK
-40 CON -40 OK
212 CON 100 OK
```



The Microtanic language card rides piggy-back on the Tanex board.

It is often said that software sells hardware; equally, it is often the documentation that sells the software. It is vital that the examples in instruction manuals — and there should be many examples — should be absolutely correct. The best examples are those printed by the computer where error in transcription is reduced to a minimum.

Microtanic manual

The manual with the Microtanic Forth says: "One of the problems in providing this package at a reasonable price was the extent of documentation that could be provided. A full set of manuals from the Forth Interest Group (FIG) costs in the region of $68".

Nevertheless, the manual could have included more example programs to illustrate the elementary use of the language. The instructions about fixing words you have defined permanently into the dictionary of the tape version are incorrect because the text reads

```
+ ORIGIN
```

in three places rather than

```
+ORIGIN
```

This tiny error stops the instruction working and would not have occurred in a computer printout.

The manual describes the implementation of Forth for the Tangerine Microtan and contains details of the comprehensive editor for writing source programs and a commented list of the words included in the Forth dictionary. Also in the package is a very useful Forth program to print the definitions of all the words in the dictionary.

Two trivial examples of Forth programming are shown here. Listing 1 is a definition of a word that will convert Fahrenheit temperatures to Centigrade. Listing 2 builds definitions into two words that will print the letter F or the number 8. Notice how the low-level command Star simply prints the ASCII character 42 * and how this is progressively incorporated into other words.

The Microtanic Forth appears to be written to the Forth 79 standard — although this is not stated explicitly in the manual — and some of the optional double-precision mathematics commands need to be constructed by the user if these are important for a particular application.

The Forth 79 standard does not include floating-point mathematics. The case is made effectively in *Starting Forth* by Leo Brodie that floating-point is often not necessary if you analyse a problem. Further, the results of a calculation can be scaled by Forth and presented to eight or more significant figures for the final answer without incurring the speed penalties associated with floating-point mathematics performed in software.

This is really the end of my special-purpose interpreter Cogent because Forth will assume its place and perform better many of the tasks I had in mind. Software is hard enough to write without trying to duplicate someone else's work unnecessarily.

It should be possible to define words in Forth to handle interrupts in the Microtan computer, and at the higher levels Forth has all the elegant clarity and ease of expression I was looking for.

FOR CONTROL

Nevertheless, the work on Cogent has been valuable if it showed you that writing a language for a defined area of computing need not be difficult and can produce useful results in applications where you want to be able to arrange a series of high-level instructions to carry out a particular set of tasks.

Although I have not touched on it in the series, you might decide, for example, to write a fast special-purpose interpreter using single-letter high-level commands for handling nothing but machine-code graphics routines for animating games programs. You should also have discovered that there are many more ways of in- and outputting information than by using a simple keyboard and VDU.

The EPROM version of Forth will coexist with Basic in the language board from Microtanic. The single-sided printed-circuit board shown in the photograph measures about 4in. by 2.5in. and has sockets for five 4K EPROMS. It allows you to switch, manually or by software commands, between Forth, Microtanic two-pass assembler, or Basic. It can be used either by plugging it directly into the J2 socket on the Tanex board and allowing it to ride the board piggy-back fashion, or by bringing a 24-way cable with DIL connectors at either end from the Tanex board to the language board. The language board would then be mounted in another part of the computer system.

Intra-system bus

Microtanic Software does not give definite information about the maximum length of cable which can be used before you can expect problems from reflections up and down what is essentially an intra-system bus and piggy-back boards are never mechanically desirable although the one in my system has worked consistently and without fault from the moment of its installation.

One problem is that the language board increases the width of the Tanex to the extent that it is impossible to plug another card into the first expansion slot on the motherboard. My motherboard had four connectors rather than the full 12, and it seems that sockets for the back plane are now as scarce as buffers and memory chips were a year ago.

However, your problems do not end when you have found the socket, for you can expect problems with the paging logic. The instructions issued by Tangerine Computer did not work with the motherboard in my system. In the end I cut the board-select line which stayed stubbornly at +4V and wired the select line permanently low to ground.

The Tangerine documentation has slipped in the past few months and although the manual for the new Tanbug is available, I have not seen a copy. I hope Tangerine will be able to regain the position it had of excellent support for a good computer.

Overall, Forth is a fascinating, sophisticated, easy-to-use software tool with a multitude of possible applications. If you are prepared to invest in a book such as *Starting Forth* or to write to a Forth interest group, I think you can acquire a significant addition to your system which will allow you a new flexibility in programming. In particular, I think Forth should be a good way of approaching subjects closely related to the theme underlying this series of articles.

1982 is Information Technology Year and one of the purposes of the Health Section of the IT82 Committee is to encourage volume production and marketing of microelectronic aids for the disabled and to reduce prices to a level where disabled people will be prepared to buy the devices or tools.

Many disabled people cannot type because they have insufficient strength in their hands. Alternative Input devices have been developed, for example a suck/blow switch can be connected to a single-bit input on the computer and that single binary input can be used to control a word processor or a computer system which will control the heating, lighting, telephone and other electrical equipment in a disabled person's home.

Forth is an ideal language in which to write routines to take information from special-purpose switches — perhaps by bouncing infra-red light off the operator's eye to pick up eye movements and blinks — to control both physical devices and the operation of ordinary commercial software in a microcomputer.

If you start thinking about designing a switch or device for use by somebody who is less able than an ordinary person, a number of factors emerge which you will have to take into account. A switch should give some feedback to the user to indicate that the switching action has taken place.

For example, some keyboards require an increasing pressure on the key until the switch has occurred and then there is a sudden give to let you know that this has happened. Other keyboards provide an audible feedback by bleeping when a key has been pressed.

It is important that operating a key repeatedly should not make the operator tired and should not cause cramp if a person is using one finger or a toe or even a stick attached to their forehead to operate the keys. Remember that this is even more important to the disabled because they are less able than an ordinary person to switch tasks to another part of their body. You can open a door with your foot if your arms are full.

Consistent response

Above all, the machine must be consistent in its response for there is nothing more frustrating to someone who is absolutely dependent on a machine than to have an inconsistent and arbitrary response. Good tools are always predictable in their actions and it is this quality that allows fine control by craftsmen and skilled workers.

You cannot iron clothes with the flat of your hand — you need a tool to do the job. In the same way, a disabled person may require a special telephone or a word processor to communicate. These aids should be available at ordinary retail outlets where you might buy an electric iron.

The combination of Forth, given some additional words in the dictionary for real-time control, with some inventive thinking and clever production engineering could generate a set of tools for the disabled. For the first time, it would be possible to build machines which could be extended and adapted by a person to perform a specific job or task.

Comparatively low-cost machines could be sold for disabled people with the capacity to carry out a wide range of jobs. The user could mould the functions of the machine to suit their own purposes. ■

Listing 2.

```
: STAR 42 EMIT ; OK
: STARS 0 DO STAR LOOP ; OK
: MARGIN CR 20 SPACES ; OK
: BLIP MARGIN STAR ; OK
: BAR MARGIN 5 STARS ; OK
: F BAR BLIP BAR BLIP BLIP CR ; OK
: BLIPS MARGIN STAR 3 SPACES STAR ; OK
: EIGHT BAR BLIPS BLIPS BAR BLIPS BLIPS BAR CR ; OK
```

```
EIGHT
                    *****
                    *   *
                    *   *
                    *****
                    *   *
                    *   *
                    *****
OK
```

```
F
                    *****
                    *
                    *****
                    *
                    *
OK
```

RESPONSE FRAME

Do you have a problem? Your manual is incomprehensible or you just cannot get the hang of that programming trick you tried — whatever it is, Tim Hartnell will do his best to answer your queries. Please include only one question per letter and mark them "Response Frame".

RANDOM NUMBERS

In the October 1981 issue, you gave what looked like a simple routine to generate random numbers on a PC-1211. However, I could not make head nor tail of the listing. As the routine in the manual is fairly long and complex, I was wondering if you could explain the original listing.

C Queriera,
Taunton, Somerset.

UNFORTUNATELY, a few gremlins crept into the original listing. Here is a version of it — set up to generate numbers in the range one to six, like a die. This routine, by the way, will work on any computer fitted with floating-point arithmetic. Some computers will need the initial value of X to be entered. The best way to do this is to add a line

```
15 PRINT "MINUTES PAST THE
   HOUR?":INPUT X
```

```
10: REM GENERATE
20: REM RANDOM NUMBERS
30: X=(X+π)∧5
40: X=X-INT (X)
50: D=INT (X*6)+1
60: PAUSE D:BEEP 1
70: GOTO 30
```

LOADING ZX-81

I have just bought a ZX-81 1K and have trouble in loading programs from my cassette player. I have tried two other cassette players which do not work either. Could you tell me which model or models could be used?

Keith Rowe,
Sunderland, Tyne and Wear.

THE ANSWER to the letter from Nicholas Heward should be of use to you.

I have been having a good deal of trouble with my ZX-81 loading system. It will not load software with Print after the line number, as used in a program with graphics in it. Why does the ZX-81 not load programs with a Print in every line? I was also wondering how long the ZX-81 can be kept in continuous operation.

Nicholas Heward,
Harrogate, North Yorkshire.

THERE SEEMS to be no reason at all why the computer should not Save a program with Prints in every line, and having saved it, allow it to be loaded back. Try the following program. If this does not work, it appears that something is wrong with your ZX-81.

```
10 PRINT
20 PRINT
30 PRINT "TEST"
40 PRINT
50 PRINT "THIS IS A TEST"
60 PRINT
```

This routine worked perfectly on our machine. You do not mention if other programs cause problems. If they do, make sure you are using computer-quality cassettes, rather than ordinary audio ones. Clean the heads before loading and saving each time, and make sure the leads for the computer and cassette connections do not cross over the lead from the power supply. Write a short program and save it. Then practise loading again and again — adjusting your cassette volume a little each time — until you achieve a perfect load. Mark the volume with a little paper arrow, and make sure you always set it at this point when loading. If you buy commercial software, make a copy of your own once you have made it load. You will find this may be easier to load subsequently than the original. Of course, it would be illegal to pass such a copy to a third party. As to your second question, ZX-81s vary from machine to machine. Some appear to lock up — in that they stop reading the keyboard — after a few hours, others will run all day. The likelihood of memory crashes, if extension memory is being used, appears to increase as the machine grows hotter, but again, it varies from computer to computer. Printout, from a printer owned by Mark Harrison, author of *Byteing deeper into your ZX-81*, shows that after about 20 minutes the printer output becomes almost unreadable. This seems to be a fault of the printer.

ZX-81 ANALYSIS

Can you suggest a program for my ZX-81 with 16K RAM to analyse figures? I wish to enter approximately six columns of figures under separate headings, to be totalled at the end. The figures are to be entered in random order. I hope you can help, as I have found your magazine the only one to explain Basic programming easily enough for us simpletons.

Bernard Kay,
Prestwich, Manchester.

WE HOPE we have understood your requirements. The following program should fill your needs. When you run it, the ZX-81 will ask

HOW MANY CATEGORIES?

If you want six different totals to be maintained, enter 6 at this point. The computer will then ask you to enter, one by one, the names by which you want each category to be known. It will say:

ENTER NAME OF CATEGORY 1

Here, for example, you enter "Nails".

ENTER NAME OF CATEGORY 2

Enter, say, "Screws". Once you have used all your categories, the screen will clear, and the number of each category, the name you have assigned to it, and the total to date will be shown, as:

1 NAILS 0   2 SCREWS 0

The computer will then ask

NUMBER OF CATEGORY

If you wish to update the Screws' total, enter 2. The word "Screws" will appear, and you enter, say, 36. The screen will clear again, and this time will print

1 NAILS 0   2 SCREWS 36

This routine will run on computers other than the ZX-81, but the means by which the names are assigned to the strings depends on the specific string handling of your computer and may well need modification.

```
 10 REM "BERNARD KAY
    PROGRAM"
 20 REM BY TIM HARTNELL
 30 PRINT "HOW MANY
    CATEGORIES?"
 40 INPUT A
 50 DIM A$(A,10)
 60 DIM Z(A)
 80 FOR C=1 TO A
 90 PRINT "ENTER NAME OF
    CATEGORY NO."; C
100 INPUT A$(C)
110 PRINT A$(C)
120 NEXT C
130 CLS
140 FOR C=1 TO A
150 PRINT C; " ";A$(C);" ";Z(C)
160 NEXT C
170 PRINT
180 PRINT "NUMBER OF
    CATEGORY?"
190 PRINT ,"-99 TO END"
200 INPUT D
210 IF D=-99 THEN STOP
220 PRINT A$(D),"VALUE?"
230 INPUT E
240 LET Z(D)=Z(D)+E
250 GOTO 130
```

BBC PROGRAMS

I am seriously considering buying the new BBC Microcomputer but there are a few points I would like your opinion on: I understand that the BBC machine is an upgraded version of the Acorn Atom, and I would like to know — as there are a large number of programs on the market for the Acorn Atom — if these would run on the BBC Microcomputer. Will the Acorn Atom users' club have a section for the BBC Micro and will the books on the Acorn Atom apply to the BBC machine? I know that certain Acorn Atoms need the floating-point ROM for some programs to run. Does the BBC Micro have floating-point; if not, can it be fitted? Will *Your Computer* be running features on the BBC Micro or will it be covered by articles on the Acorn Atom?

Glynn Mitchell,
Sheffield.

THE BBC Microcomputer is a new computer developed from the Acorn Atom, rather than an upgraded Atom. It uses a new, more flexible, and in our opinion, much better implementation of Microsoft Basic. The majority of Atom programs will not run as they are, but can easily be modified to run on the BBC machine. Despite this, Sigma Technical Press has published a book by David Johnson-Davies, who created much of the Atom and the BBC Micro, entitled *Practical programs for the BBC Microcomputer and the Acorn Atom*, which suggests they may be reasonably compatible. The Independent Acorn Atom Users' Group, 44-46 Earls Court Road, London W8 6EJ, is incorporating BBC material in its monthly newsletter. The BBC machine has floating-point arithmetic as standard, so no additional ROM is need to provide this. As you will have seen in the February issue, we will certainly be providing articles for owners of BBC machines.

REVERSE VIDEO

In your January 1982 issue of the magazine, page 61, I read the article on "Keyboard changes" by D Butler, and also read there was a modification on the printed-circuit board to reverse the video display on the ZX-81. If so, would you please let me know what it is?

Raymond Krug,
Felixstowe, Suffolk.

UNFORTUNATELY, there is no simple way to reverse the video on a ZX-81, whereas it is very easy on the ZX-80.

WORD PROCESSOR

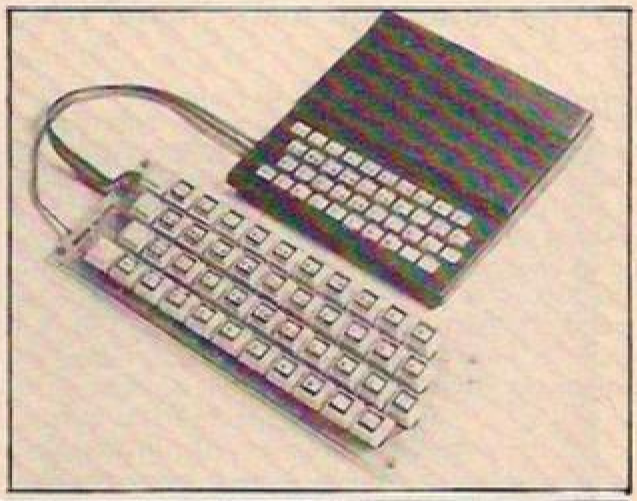
The system I am seeking must be capable of word processing and produce hard copy to the same standard as commercial word processors. I am aware of the fully expanded Atari 800 system, but do not know how this compares to other systems.

K Weston-Lewis,
Wood Green, London.

YOU DO NOT say, besides word processing, what you wish to use your computer for, and these other uses may well dictate the system you buy. The quality of the output depends, to a large extent, on how much you are prepared to spend on the printer you couple to your computer. A relatively low-cost system could be created from an Acorn Atom using the word processor ROM, and attaching a printer. A cheap one to print on aluminium paper is available, but the results are probably not as good as you may require. An Atom, with word processor ROM, driving a Centronics 737 dot-matrix printer, is perfectly satisfactory, but not, of course, as good as the output from a daisywheel printer. Good word-processing packages are available for a number of computers, including the Pet and Apple series. Overall, though, the quality of output depends on how much you pay, and the machine you buy will depend on the other functions you need it to provide. ■

ZX 80/81 HARDWARE/SOFTWARE

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The keyboard has been specially designed for the Sinclair computer and is supplied ready-built. It also has facilities for 4 extra buttons which could be used for on/off switch, reset, etc. **£27.95**

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16K 81 SOFTWARE

As seen at the ZX Microfair.
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FINGERTIPS

Fingertips is our regular calculator column covering calculator news, programming hints and examples of unusual applications. The column is written and compiled by calculator enthusiast David Pringle who is glad to hear of any of your ideas. *Your Computer* pays £6 for each of your contributions published.



I RECENTLY RECEIVED a very well-packaged parcel from Tempus of Cambridge. After ripping through what seemed like a large forest's worth of cardboard and newspaper I was all ready to declare it a hoax when I discovered a small box containing Casio's new Mini Electro printer.

The nicely-contoured black plastic FP-10 printer is compatible with the FX-600/700 series. It prints characters in a five-by-seven dot matrix by an electric discharge from seven small electrodes on to a fairly narrow 35mm. roll of metallised paper. Hence the printer is a good 3W source of electromagnetic radiation, sufficient to cause interference to radio communications — according to the instruction manual — and a bright little display of pyrotechnics if you dim the lights. DC power for up to 7,000 lines of printing may be supplied by four AA-size batteries, although a rechargeable battery pack or AC adaptor may be bought separately.

I have not used the adaptor yet: the warning on page three of the manual blandly states that "When using an AC adaptor erroneous printing may occur", which sounds a trifle ominous. The printer will reel off two lines a second at up to 20 characters per line. Quite an improvement on Caxton.

I only used the printer in conjunction with a 602-P but received the impression from the manual that the 702-P facilitates slightly easier and less roundabout usage of the FP-10. The command for printing a displayed line or program result on my machine is a laborious

INV SAVE , INV EXE.

Hence, to print out a variable A which has just been calculated in a program I would have to write

INV ALPHA , A , = , INV ≠ ,
INV ALPHA , INV SAVE , INV EXE.

I found it handy to assign the last four keystrokes to program memory. The 702-P has a more easily remembered and logical PRT command.

Other options available for both calculators are selective or full printing of program listings and all of the memory values. The listing on the 600s has to be performed in PCL mode. This can be annoying, especially as there is quite a rigmarole to eke out a program which has a password. What if you make a mistake in your keying-in and press the AC button instead of the C? Not only is your program not printed but it disappears from the face of the Earth. Music-lovers have the extra bonus of being able to obtain a printing of one of their scores.

So, what is the verdict? The FP-10 is a handy, compact device which gives a high-quality printout, though it does have a mind of its own in deciding how to lay out its listings, which can be disconcerting. For some reason, displayed data starts printing five characters from the right and displayed text, as expected, from the first space on the left. At over half the price of the 602-P it is hardly cheap. I look forward to someone dreaming up some fancy graphics.

In January's *Your Computer* I refreshed your memory on the fundamental unit of any programmable calculator — the byte. Remember that in the HP-41C the same bytes are used for totally different purposes in program, data and alpha-numeric memory. The machine's interpreter only allows certain byte combinations to enter into program memory — if you confuse it you can create "synthetic" lines, some of which are very handy indeed. The most basic way to anaesthetise the interpreter is with the byte jumper, an assigned key command which jumps into the middle of alpha-numeric character strings.

- Perform a Master Clear.
- Insert a memory module and execute SIZE 000.
- Key in ASN "X" shift +, and ASN "Σ +" Σ +.
- Switch the machine off and remove the memory module. Wait at least one minute before replacing.
- Turn the calculator back on and switch to Program mode. You should see 00 REG 126. Press SST once and after a few seconds the display appears as 01^T.

This rigmarole has actually caused the machine to lose its permanent .END. which separates programs from the rest of memory. It used to live inside the memory module until you starved it of its lifeblood — charge.

January's memory layout table makes it quite clear where you are. The SST command has taken you to the first non-zero byte below the Data memory partition — the first assignment register. The display 01^T represents the zero character-string byte, actually stored as F0 in hex, which is present to indicate a register containing assignment information.

SST up to line 06 and you will see all of the assignment coding bytes interpreted as program lines. Altering these lines now amounts to assignment editing.

To do just that, return to line three, press the correction key twice and insert the text line 02^T A. Now perform a GTO . . . and after a very swift PACKING has appeared on the display, SST once and delete the line 01 LBL 01. Return to Normal mode.

You have just entered a user-definable command called the byte jumper. It was made possible by the editing performed on the assignment registers which carry all of the information on the user-definable keys. Of all of the possible combinations of non-normal assignment bytes, this is one of the few which actually performs something. Change to User mode and press the Σ + key. You will see the display

XROM 05,01.

This is the interpreter's name for your assignment, which may be accessed by the Σ + key.

The XROM part of the display signifies that the function is not listed internally by catalogue three. You have actually assigned a two-byte function, the 05,01 part being derived from the last nybble of the first byte and all of the second byte. As the range of such XROM commands is 1½ bytes, the HP-41 is capable of executing 2^{12} or 4096 non-standard functions.

So what does the byte jumper actually do? It permits the line marker in program memory to jump a determined number of bytes into the middle of an alpha-numeric string. The bytes that are jumped over are, as is usual when an alpha-numeric string is encountered, transferred into the alpha-numeric register. The remaining bytes are then interpreted as stand-alone functions.

For instance, key in the following lines. The numbers to the right of the line are the numbers in hexadecimal, which are stored in the memory bytes

01	STO 01	31
02^T	BJ	F2 42 4A

If you now "byte jump" — by going out of program mode and pressing the Σ + key — from line two, the first byte of the line is transferred into the alpha register and so the next two, having lost the character-string marker, are interpreted as normal program bytes.

It is important to note that at this stage the program has just been misinterpreted and that the original bytes remain as they were in memory. But if, after byte jumping, when the program marker lies between bytes 42 and 4A, you enter new program lines, then you will permanently split up the BJ text line.

The number of bytes which are transferred to the alpha register is purely determined by the value of the last nybble of the line preceding the program marker. Thus, if the first line had been STO 03 — value 33 in hex — then all of the bytes would have been transferred.

Now that you have the basis of creating non-normal lines at your fingertips you can get on with discovering many of the untold mysteries of the HP-41C. If you find any useful or amusing byte combinations then do write in to *Your Computer* and let us know.

For further useful information you can write for details of synthetic programming to Larken Publications, 4517 NW Queen's Avenue, Corvallis, Oregon, 97330, U.S.A.

Note that the byte-jumping routine will not directly work on the HP-41CV. A specially-written bar code, available from Larken, will do the job.

END statement and program labels both form part of what is called the global chain of program memory. The calculator maintains a linked list in RAM of all their absolute addresses.

Three nybbles are needed to define an address: three bits for the byte within the register and nine bits for the register. So when the calculator attempts to find out what the previous instruction in RAM is, it jumps back up the global chain until

(continued on next page)

```
                          0 STO-0 CLEARS SCORE REGISTER
FIRST DIGIT OF GUESS        STO-1
SECOND DIGIT OF GUESS       STO-2
THIRD DIGIT OF GUESS        STO-3
                            X⇌T PLACES LAST DIGIT OF
                                GUESS IN THE COMPARISON
                                REGISTER (MEMORY 7)
                            R/S GO!
```

Listing 1. Keystroke sequence to enter your guess.

(continued from previous page)

it reaches a global with an absolute address which is higher than the current address-counter contents. This may not be the top of the current file, and you can make use of this while editing a lengthy program by inserting a label, e.g., Edit, at the place where the lowest-numbered line will be edited. This considerably speeds up the backward jumping and, once you have finished, the label can easily be found for deletion.

An END needs a full three bytes of memory: three nybbles are required for the address, and one more nybble is needed to let the interpreter know that it is a global instruction. The third byte is used to provide information on the current program, i.e., whether it has been packed and whether it is the last program in memory.

Frank Wales, my Scottish calculator guru, assures me that there is an intermediate state in which the calculator may be found. This occurs when you have just edited a program, but have not packed it. The last nybble of the END is then different to that for a usual packed or unpacked program.

The calculator uses this as a sign that rapid branch jumps — stores in GTOs and XEQs — may be incorrect and these must be updated. Such updating occurs when you switch out of Program mode and this is why there may be a delay when you press the PRGM key.

One problem which Hewlett Packard has discovered with this is that you can switch the calculator off without getting out of Program mode. On switching the calculator back to Normal mode it will not have recompiled the addresses. So to be on the safe side, toggle the PRGM switch on and off after an editing session.

In an attempt to while away several hours on a snowbound train, Roger Davis of Woking has written a Mastermind program for the TI-57 Programmable. The calculator generates a three-digit number which the player must deduce.

- Steps 00 to 05 store an "unknown" number of three digits in memories 4, 5 and 6.
- Steps 06 to 08 display score and relocate program for next guess.
- Steps 09 to 19 arrange memories for comparison.
- Steps 20 to 29 are a subroutine for generating "random" digits for the "unknown" number.
- Steps 30 to 42 are a comparison subroutine.
- Steps 43 to 45 are a subroutine for scoring correct digit in correct place.
- Steps 46 to 49 are a subroutine for scoring correct digit in wrong place.

The game is played as follows:

- Enter program and reset.
- Enter a decimal fraction of any length into the display, e.g., .42775.
- Press STO-7 then R/S. When the sequence is finished, the contents of memory 0 — the score register — are displayed.
- Enter the first guess at the three-digit number using the keystroke sequence in listing 1. The calculator will now compare each digit of the guess with each digit of the unknown number. The program returns to the correct place for entering the next guess, and displays the score for the last guess. It will score the digit itself for each correct digit in the correct place, and 1 for each correct digit in the wrong place. For example, if the unknown number is 539:

953 will score 3,
735 will score 4,
579 will score 14,
539 will score 17.

Because every digit of the guess is compared with every digit of the "unknown", apparently anomalous scores are obtained when the same digit is repeated in the guess. In the above example, a guess of 555 will score 7, not 5.

- Repeat the "guess" sequence for subsequent guesses. The unknown digits may be retrieved by recalling memories 4, 5 and 6 in that order.
- To play again, reset and start from stage (2) above.

It helps considerably to have a pencil and paper handy.

Finally, we have some observations on the Casio Scientific FX-81 from Christopher Gill of High Wycombe, Buckinghamshire. The FX-81 is based on the discontinued FX-80 calculator, the most important difference between the two being that the FX-80 College has a standard-deviation function. The mode-selection key DRG, when pressed after the INV key, causes the sign SD to appear in the bottom, right-hand corner of the read-out. Then data can be entered using the memory plus M+ key. Using the third row of function keys — keys 1/k, X ↔ Y, etc. — you can display the functions Σx^2, Σx, n, $\bar{x}$, σn, and σn-1, for any number of values of the variable x.

The FX-81 does not have this feature on its keyboard. Press INV followed by DRG and the error sign appears in the bottom, right-hand corner of the readout. If you ignore the error sign, and enter data using M+ as in the case of the FX-80, you will find that it works exactly like the FX-80. You can obtain the arithmetic mean, population standard deviation, sample standard deviation, number of data (n), sum of x, and sum of x^2, at the touch of one of the keys.

Similarly there are other functions of the FX-80 that are omitted from the keyboard of the FX-81 but which nevertheless work in exactly the same way on the two calculators. The + key can be used after pressing INV and using X ↔ Y to convert rectangular to polar co-ordinates.

Given values of x and y, key in x, INV, +, y, =, and the value of r appears. Then key in X → Y, and you get the value of angle θ. The minus key converts from polar to rectangular co-ordinates: key in r, INV, −, θ, =, and the value of x appears. Then key in X ↔ Y, and you get the value of y.

The other two functions you need to know are used when calculating standard deviations using INV, DRG. INV followed by AC clears all the data entered, and INV followed by M+ deletes one value of x that has been wrongly entered.

Can anyone explain why Casio should sell a calculator and deliberately hide from the user these extra functions that it possesses? ■

Listing 2. Mastermind for TI-57 Programmable.

STEP	KEYSTROKE	STEP	KEYSTROKE
00	SBR-1	25	EE
01	STO-4	26	1
02	SBR-1	27	2nd INT
03	STO-5	28	INVEE
04	SBR-1	29	INVSBR
05	STO-6		
		30	2nd LBL-2
06	2nd LBL-0	31	2nd X=T
07	RCL-0	32	GTO-3
08	R/S	33	RCL-4
		34	2nd X=T
09	RCL-6	35	GTO-4
10	SBR-2	36	RCL-5
11	RCL-2	37	2nd X=T
12	STO-7	38	GTO-4
13	RCL-5	39	RCL-6
14	SBR-2	40	2nd X=T
15	RCL-1	41	GTO-4
16	STO-7	42	INVSBR
17	RCL-4		
18	SBR-2	43	2nd LBL-3
19	GTO-0	44	SUM-0
		45	INVSBR
20	2nd LBL-1		
21	RCL-7	46	2nd LBL-4
22	2nd INVCOS	47	1
23	2nd INVINT	48	SUM-0
24	STO-7	49	INVSBR

THREE PET TITLES from Nick Hampshire

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A book which will save the software designer considerable time by providing 55 proven subroutines to integrate with his own programmes.

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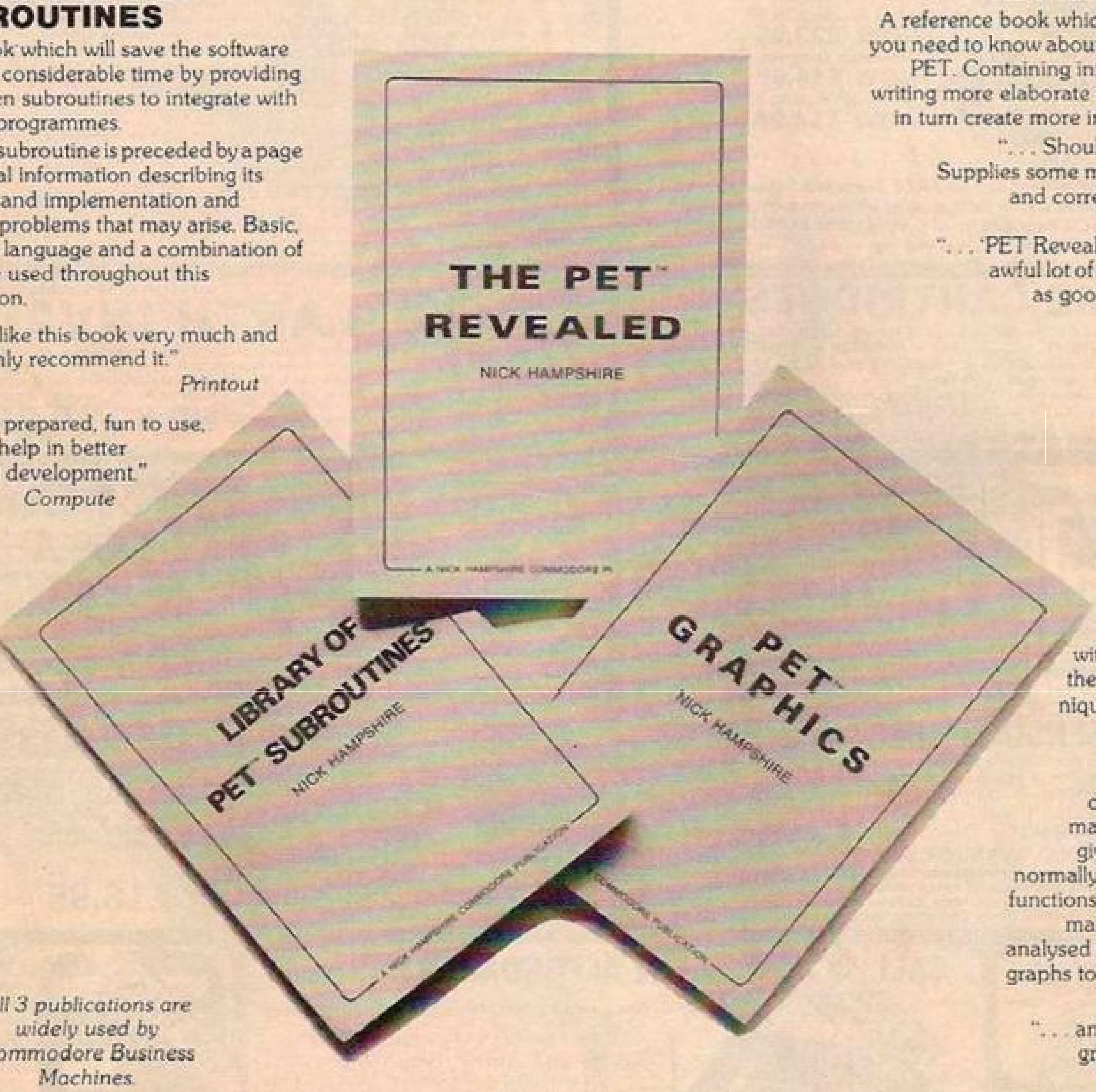
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PET GRAPHICS

This book has two objectives. One, to provide the reader with an introduction to the programming techniques used to generate graphic displays. Two, providing the programmer with a complete package of machine code routines giving a wide range of normally unavailable graphic functions. The book contains many comprehensively analysed routines and photographs to illustrate the effects created.

"... an invaluable guide to graphics on the PET."
Micro Forecast

All 3 publications are widely used by Commodore Business Machines.

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Silent running

S A Nicholls,
Keynsham, Bristol.

ZX-81

THIS FLICKER-free game program is written for the ZX-81 in machine code. It is only suitable for machines with from 1K to less than 3.5K RAM, because of the way the background is printed.

The object of the game is to hit a submarine with a depth charge in the shortest time possible. The display occupies the full screen. Movement of your ship is controlled by key 5 for left and 8 for right. The ship has twice the speed of the submarine. A depth charge is dropped by pressing the 0 key.

The display has a counter which starts at 999 and counts down in ones to zero in roughly 25 seconds. The game finishes when the counter reaches zero or when a submarine is hit, at which point the counter will stop at your score. The submarine travels from right to left and its speed decreases continuously as the game progresses to give more time to hit it. The first pass takes approximately one second.

The depth of the submarine also increases with each pass of the screen. When it reaches the sea-bed the next pass will be at the top of the sea and so on. To enter the program which is written for a line-1 Rem statement, the following Basic program can be used:

```
1 REM — followed by 323 zeros — for
    machine-code store
10 LET X = 16514
20 LET A$ = ""
30 IF A$ = "" then input A$
40 IF A$ = "S" then stop
50 POKE X, 16* code A$ + code A$ (2) - 476
60 LET X = X + 1
70 LET A$ = A$ (3 TO)
80 GOTO 30
```

This program will allow you to enter blocks of machine-code at each input prompt. I find it easier to enter one line at a time. For example, 0606 Newline 3E 76 Newline D7 and so on. After the last byte, C9 is entered. Then input S to stop the program.

The Basic program is best entered and Run in Fast mode, as 323 zeros take some time to enter in Slow. After entering the machine-code, delete lines 10 to 80 and insert:

```
10 IF NOT USR 16514 THEN PRINT "MISSED"
```

The program should now be saved so that if mistakes have been made in entering the code, you will not have to start again but just reload and check the listing by Peeking at each address from 16514 to 16839. All that is needed now is to type Run as a direct command and the game can be played.

```
(16514) 06  06          START
                3E  76
        D7
        10  FD
        AF
        D7
        3E  25
        D7
        D7
        D7
        3E  76
        D7
        D7              PRINT
        06  40          BACKGROUND
        3E  0E
        D7
        10  FD
        21  40  01
        3E  88
        D7
        2B
        7C
        B5
        20  F8
        06  20
        3E  80
        D7
        10  FD
        2A  0C  40      INITIALISE
        11  4A  00      SHIP POSITION
        19
        22  3C  40
        21  00  01      SET START SPEED
        22  44  40
        2A  32  40
        23
        22  32  40
        7D
        E6  07
        CE  05
        CD  19  15
        3E  21          INITIALISE
        CD  19  15      SUB POSITION
        EF
        04
        34
        CD  A7  0E
        2A  0C  40
        09
        11  09  00
        19
        22  40  40
        01  00  00      LD BC,0
(16613)-2A 44 40
                23
        22 44 40
        2A 44 40        INCREASING DELAY
        2B
        7C
        B5
        20 FB
        2A 0C 40
        11 0A 00
        19
        7E
        A7
        20 08
        06 03
        23              DECREASE SCORE
        36 1C
        10 FB
        C9
        3D
        FE 1B
        20 05
        36 25
        2B
        18 EA
        77
        04
        CB 40           MOVE SHIP AT
        20 66           TWICE SPEED
        2A 40 40        OF SUB
        7E
        FE BB
        CA B6 41
```

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```
           36 88
           23
           36 88
           23
           36 88
           2B              MOVE SUB
           2B
           2B
           7E
           FE 76
           28 8D
           22 40 40
           36 8A
           23
           36 B1
           23
           36 8A
           AF
           B9              CHECK FOR DEPTH
           20 13           CHARGE DROPPED
(16703)-3A 26 40           CHECK 0 KEY
           FE FD           PRESSED
           20 38
           0E 01
           2A 3C 40
           11 22 00        INITIALISE
           19              D/CHARGE
           22 42 40
           2A 42 40        MOVE D/C
           36 88
           11 21 00
           19
           7E              CHECK FOR SEA BED
           FE 80
           20 04
           0E 00
           18 1A
           7E
           FE B1           CHECK HIT
           28 4D
           2A 40 40
           2B
           7E              CHECK SUB AT
           FE 76           END OF LINE
           28 EE
           2A 42 40
           11 21 00
```

```
           19              PRINT D/C
           36 BB           AND STORE NEW POSITION
           22 42 40
           2A 3C 40
           36 0E           MOVE SHIP
           23
           36 0E
           23
           36 0E
           3A 26 40
           FE DF           CHECK LEFT
           20 0B           KEY 5
           2B
           2B
           2B
           7E
           FE 76
           20 10
           23
           18 0D
           FE F7           CHECK RIGHT
           20 07           KEY 8
           23
(16800)-7E
           FE 76
           20 01
           2B
           2B
           2B
           22 3C 40        STORE NEW
           36 86           POSITION
           23
           36 BB           REPRINT SHIP
           23
           36 06
           C3 E5 40        JP DELAY
           2A 40 40
           36 A7
           23              HIT SUB
           36 B4
           23
           36 B4
           23
           36 B2
(16836)-C9                 RETURN TO BASIC
10 IF NOT USR 16514 THEN PRINT
                    "MISSED"
```

Load warning

G Sleet,
Tuffley, Gloucester.

ATOM

MANY TIMES I have sat staring at my Atom's screen, waiting for it to finish loading my latest program, only to discover that the tape lead is not plugged in. This program gets around this problem by making the Atom's internal loudspeaker buzz and the top, right-hand corner of the screen flash when the Atom is loading from tape.

It is done by redirecting the OSBGET routine to the machine-code routine in the program, line 240. Now the Atom loads each byte from the tape as normal, but then plays it through the internal loudspeaker of the Atom and stores it in location 801F hex on the screen before processing it, lines 35 to 60.

Lines 65 to 210 produce a bleep whenever the OSWRCH routine is called, i.e., whenever a character is printed on the screen OSWRCH is redirected to this routine in line 250. The bleep is produced from lines 130 to 180, using the method described on page 114 of the Atom manual.

The frequency of the bleep depends on the value of the ASCII code of the character printed. The length of the bleep depends on the value of location 83 hex which can be changed as required.

The bleep can be turned on or off by keying CTRL-1 in direct mode or using Print $17 in a program. Both of these routines are stored in the free space of the floating-point RAM from 28C0 hex to 28FF hex and so it should work on any Atom with at least 1K RAM in the lower text space.

Once the program has been run it is no longer needed, so type New and use the Atom as normal. The routines will still remain intact and can be saved on tape by typing:

*SAVE"LOAD/BLEEP"28C0 28FF

The next time you want to load the subroutines, type:

*LOAD"LOAD/BLEEP"

To start the BGTVEC routine type:

?# 214 = # C0;?# 215 = # 28

To start the WRCVEC routine type:

?# 208 = # CA;?209 = # 28

If you have typed in the hex dump, or pressed the Break key, the two routines must be started up again in the same way.

```
G. SLEET  ATOM LOAD BLEEP

1 DIM VV3
10 PRINT $21
20 FOR I=1 TO 2;P=#28C0
30 [
35\BGTVEC ROUTINE:
40 JSR #FBEE
50 STA #801F;STA #B002
60 RTS
65\WRCVEC ROUTINE:
70 JSR #FE52
80 STA #80;STX #81;STY #82
90 CMP@17;BNE VV0
```

```
100 LDA #84;EOR@#FF;STA #84
110:VV0
120 LDA #84;BPL VV1
130 LDY #83;LDA #B002
140:VV2
150 LDX #80
160:VV3 DEX;BNE VV3
170 E0R@4;STA #B002
180 DEY;BNE VV2
190:VV1
200 LDA #80;LDX #81;LDY #82
210 RTS
220 ]
230 NEXT I;PRINT $6
240 ?#214=#C0;?#215=#28
250 ?#208=#CA;?#209=#28
260 END
     hex dump of load bleep routine:
28C0 20 EE FB 8D 1F 80 8D 02
28C8 B0 60 20 52 FE 85 80 86
28D0 81 84 82 C9 11 D0 06 A5
28D8 84 49 FF 85 84 A5 84 10
28E0 12 A4 83 AD 02 B0 A6 80
28E8 CA D0 FD 49 04 8D 02 B0
28F0 88 D0 F3 A5 80 A6 81 A4
28F8 82 60 00 00 00 00 00 00
```

Molecules

ZX-81

B G Cornhill,
Aylesbury, Buckinghamshire.

THIS IS a 5.7K program for playing the game Molecules on your expanded ZX-81. The computer constructs a molecule from one to seven atoms in size and you have to guess its shape. You do this by shining imaginary rays of light and then trying to calculate the positions of the atoms from the deflection recorded.

A ray of light striking an atom straight on is totally absorbed and produces a black square at point of entry. Reflected rays are turned through 90° when they strike an atom a glancing blow. A ray entered at 28 was turned left at the first atom it encountered, then left twice more causing it to U-turn, then turned again by 90° to exit at the same place it entered.

A ray that glances an atom immediately on entry is reflected straight out and marked by an inverse-video 0. Entering P allows you to plot guesses, or alter any guesses you have made. When you have had enough, enter F. The computer will then display the actual location.

To allow conversion to other machines, here are the program lines and their various CHR$.

Lines 10 to 77 display the instructions on the screen.

Lines 80 to 330 draw the grid with all the numbers intact, and a blank grid.

Line 340 initialises the array used to hold the grid information. It is larger in size than required purely to facilitate the grid search and screen printing. The first figures are for the line ,0 at the top; the second figures are for the columns ,0 on the left.

Lines 350 to 370 ask for the number of atoms — one to seven. Seven seems to be enough, but this can be increased.

Lines 380 to 420 randomly locate the atoms to the array.

Line 430 is the starting point and re-entry point of the rest of the program. It is here you are asked the entry point. You enter your choice of 1-8, 9-16, 17-24, 25-32.

Lines 1330 to 1400 is the routine for entering your guesses or editing your guesses.

Lines 1400 to 1480 is the end routine which displays the shape.

Lines 450 to 510 calculate which side you are entering from and send you to the correct routine.

Line 520 is an error check.

Lines 540 to 620 contain the routine for the light moving down the array and check ahead for either total absorption, deflection or passing straight through.

Line 640 exits if you are deflected to the right.

Line 670 exits if you are deflected to the left.

Lines 671 to 860 contain the routine which checks from left to right.

Lines 870 to 1090 is the routine which checks from bottom to top.

Lines 1100 to 1320 is the routine which checks from right to left.

Each of the direction routines must cater for entry part of the way into the routine and for leaving it before it is finished. Hence, the absence of Gosubs: they could confuse the return statements. For example, entry at 28 used the left-to-right routine, then bottom to top, then right to left, then top to bottom, then right to left leaving at the entry point totally deflected.

The use of the Q numbers is to allow the computer to place the correct graphic symbol at the entry point and exit point. When you have entered the program, line 1490 must be entered initially with the normal S command for the word atoms. When you are ready to record, enter Run 1490 and it will always start automatically on loading.

```
10 PRINT TAB 13;"ATOMS"
20 PRINT
30 PRINT "THE GAME OF ATOMS. FIRST
ENTRY IS TO SET THE NUMBER OF
ATOMS IN THE MOLECULE FROM 1 TO 7."
40 PRINT "CHOOSE YOUR ENTRY POINT.
A ▧  WILL APPEAR AT ENTRY. A ■ FOR
NO EXIT. AND AN ▪▪ FOR AN EXIT."
50 PRINT "ENTER""P""IF YOU WANT TO
PUT A TEST ATOM ON THE GRID. TO
REMOVE IT PLACE A SPACE."
60 PRINT "WHEN YOU FINALLY DECIDE
TO STICK ENTER""F"""
70 PRINT "PRESS N/L WHEN READY"
75 INPUT A$
77 CLS
80 PRINT AT 2,7;CHR$ 135;AT 2,23;
CHR$ 4;AT 18,7;CHR$ 2;AT 18,23;CHR$ 1
90 LET O=2
100 FOR N=1 TO 8
110 PRINT AT 1,6+O;N
115 LET O=O+2
120 NEXT N
125 LET O=2
140 FOR N=9 TO 16
150 PRINT AT 1+O,24;N
155 LET O=O+2
160 NEXT N
165 LET O=2
170 FOR N=32 TO 25 STEP -1
180 PRINT AT 1+O,5;N
185 LET O=O+2
190 NEXT N
200 PRINT AT 19,8;"2 2 2 2 2 1 1 1"
210 PRINT AT 20,8;"4 3 2 1 0 9 8 7"
220 FOR N=0 TO 14
225 PRINT AT 3+N,7;CHR$ 133
226 PRINT AT 3+N,23;CHR$ 5
230 PRINT AT 2,8+N;CHR$ 131
240 PRINT AT 4,8+N;CHR$ 22
245 PRINT AT 6,8+N;CHR$ 22
250 PRINT AT 8,8+N;CHR$ 22
255 PRINT AT 10,8+N;CHR$ 22
260 PRINT AT 12,8+N;CHR$ 22
265 PRINT AT 14,8+N;CHR$ 22
270 PRINT AT 16,8+N;CHR$ 22
275 PRINT AT 18,8+N;CHR$ 3
276 NEXT N
277 FOR N=0 TO 14 STEP 2
285 PRINT AT 3+N,9;CHR$ 14
290 PRINT AT 3+N,11;CHR$ 14
295 PRINT AT 3+N,13;CHR$ 14
300 PRINT AT 3+N,15;CHR$ 14
310 PRINT AT 3+N,17;CHR$ 14
315 PRINT AT 3+N,19;CHR$ 14
320 PRINT AT 3+N,21;CHR$ 14
330 NEXT N
340 DIM A(11,10)
350 PRINT AT 21,0;"NUMBER OF ATOMS
1 TO 7"
360 INPUT AT
365 RAND
370 IF AT<1 OR AT>7 THEN GOTO 360
380 FOR N=1 TO AT
390 LET B=INT (RND*8)+2
400 LET B1=INT (RND*8)+2
410 LET A(B,B1)=99
420 NEXT N
430 PRINT AT 21,0;"ENTRY NO,P O
R F        "
440 INPUT A$
445 LET D=2
450 IF A$="P" THEN GOTO 1330
460 IF A$="F" THEN GOTO 1410
```

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ADVENTURE GAMES

(continued from page 67)

```
470 LET P=VAL A$
480 IF P*(P>0 AND P<9)>0 THEN GOTO 540
490 IF P*(P>8 AND P<17)>0 THEN GOTO 1100
500 IF P*(P>16 AND P<25)>0 THEN GOTO 870
510 IF P*(P>24 AND P<33)>0 THEN GOTO 671
520 PRINT AT 21,0;"WRONG
530 GOTO 440
535 REM DOWN
540 LET P=P+1
550 PRINT AT 1,5+(P*2-1);CHR$ 136
555 LET Q1=1
556 LET Q2=5+(P*2-1)
560 IF A(D,P)=99 THEN PRINT AT
Q1,Q2;CHR$ 128
565 IF A (D,P)=99 THEN GOTO 430
570 IF A(D,P-1)=99 THEN GOTO 620
580 IF A(D,P+1)=99 THEN GOTO 650
590 LET D=D+1
600 IF D>9 THEN PRINT AT 19,5+(
610 IF D>9 THEN GOTO 430
615 GOTO 560
620 IF D<=2 THEN PRINT AT 1,5+(P*2-1); CHR$ 180
630 IF D<=2 THEN GOTO 430
635 LET D=D-1
640 GOTO 770
650 IF D<=2 THEN PRINT AT 1,5+(P*2-1); CHR$ 180
660 IF D<=2 THEN GOTO 430
665 LET D=D-1
670 GOTO 1230
671 IF P=32 THEN LET D=2
672 IF P=31 THEN LET D=3
673 IF P=30 THEN LET D=4
674 IF P=29 THEN LET D=5
675 IF P=28 THEN LET D=6
676 IF P=27 THEN LET D=7
677 IF P=26 THEN LET D=8
678 IF P=25 THEN LET D=9
680 REM RIGHT
725 LET P=2
726 PRINT AT D*2-1,6;CHR$ 136
728 LET 01=D*2-1
729 LET 02=6
730 IF A (D,P)=99 THEN PRINT AT 01, 02;CHR$ 128
740 IF A (D,P)=99 THEN GOTO 430
750 IF A (D-1,P)=99 THEN GOTO 810
760 IF A (D+1,P)=99 THEN GOTO 840
770 LET P=P+1
780 IF P>9 THEN PRINT AT D*2-1,24;CHR$ 136
790 IF P>9 THEN GOTO 430
800 GOTO 730
810 IF P<=2 THEN PRINT AT D*2-1,6;CHR$ 180
820 IF P<=2 THEN GOTO 430
825 LET P=P-1
830 GOTO 590
840 IF P<=2 THEN PRINT AT D*2-1,6;CHR$ 180
850 IF P<=2 THEN GOTO 430
855 LET P=P-1
860 GOTO 1000
865 REM UP
870 IF P=17 THEN LET P=9
880 IF P=18 THEN LET P=8
890 IF P=19 THEN LET P=7
900 IF P=20 THEN LET P=6
910 IF P=21 THEN LET P=5
920 IF P=22 THEN LET P=4
930 IF P=23 THEN LET P=3
940 IF P=24 THEN LET P=2
950 LET D=9
955 PRINT AT 19,4+P*2;CHR$ 136
956 LET 01=19
957 LET 02=4+P*2
960 IF A(D,P)=99 THEN PRINT AT 01,02;CHR$ 128
970 IF A(D,P)=99 THEN GOTO 430.
980  IF A (D,P-1)=99 THEN GOTO 1040
990  IF A (D,P+1)=99 THEN GOTO 10
1000 LET D=D-1
1010 IF D<=2 THEN PRINT AT 1,4+P*2;CHR$ 136
1020 IF D<=2 THEN GOTO 430
1030 GOTO 960
1040 IF D>=9 THEN PRINT AT 19,4+P*2;CHR$ 180
1050 IF D>=9 THEN GOTO 430
1055 LET D=D+1
1060 GOTO 770
1070 IF D>=9 THEN PRINT AT 19,4+P*2;CHR$ 180
1080 IF D>=9 THEN GOTO 430
1085 LET D=D+1
1090 GOTO 1230
1095 REM LEFT
1100 IF P=9 THEN LET D=2
1110 IF P=10 THEN LET D=3
1120 IF P=11 THEN LET D=4
1130 IF P=12 THEN LET D=5
1140 IF P=13 THEN LET D=6
1150 IF P=14 THEN LET D=7
1160 IF P=15 THEN LET D=8
1170 IF P=16 THEN LET D=9
1180 LET P=9
1185 PRINT AT D*2-1,24;CHR$ 136
1186 LET 01=D*2-1
1187 LET 02=24
1190 IF A (D,P)=99 THEN PRINT AT01,02;CHR$ 128
1200 IF A (D,P)=99 THEN GOTO 430
1210 IF A (D-1,P)=99 THEN GOTO 1270
1220 IF A (D+1,P)=99 THEN GOTO 1300
1230 LET P=P-1
1240 IF P<=2 THEN PRINT AT D*2-1,6;CHR$ 136
1250 IF P<=2 THEN GOTO 430
1260 GOTO 1190
1270 IF P>=9 THEN PRINT AT D*2-1,24;CHR$ 180
1280 IF P>=9 THEN GOTO 430
1285 LET P=P+1
1290 GOTO 590
1300 IF P>=9 THEN PRINT AT D*2-1,24;CHR$ 180
1310 IF P>=9 THEN GOTO 430
1315 LET P=P+1
1320 GOTO 1000
1325 REM GUESS
1330 PRINT AT 21,0;"GRID LINE DOWN 1 TO 8
1340 INPUT G1
1350 PRINT AT 21,0;"GRID LINE ACROSS 1 TO 8
1355 INPUT G2
1356 PRINT AT 21,0;"ENTER * OR SPACE
1357 INPUT G$
1360 PRINT AT G1*2+1,G2*2+6;G$
1370 PRINT AT 21,0;"ANOTHER GUESS Y OR N
1380 INPUT A$
1390 IF A$="Y" THEN GOTO 1330
1400 GOTO 430
1415 FOR L=1 TO 11
1420 FOR M=1 TO 10
1450 IF A (L,M)=99 THEN PRINT ATL*2-1,M*2+4;CHR$ 151
1460 NEXT M
1470 NEXT L
1480 STOP
1490 SAVE "ATOM█"
1500 GOTO 10
```

Card tricks

L Cunningham,
Rainham, Essex.

ZX-81

BASED ON A WELL-known television game in which contestants predict the relative values of playing cards, this program will run on a ZX-81 with 16K RAM.

The screen displays two rows of concealed playing cards. In turn each card is revealed from left to right in response to the pressing of keys L — lower — or H — higher. The first card in each row may be changed by pressing key C — change.

Pressing key S — stick — will protect the cards already revealed and transfer play to the opponent. An incorrect prediction will result in all cards to the right of the stick marker being cancelled and play returning to the opponent. The object of the game is to complete five rows of cards before the opponent.

```
  1 REM L. CUNNINGHAM. 1981.
  5 RAND
 10 DIM C(15)
 20 DIM P(15)
 30 DIM L(15)
 40 DIM S(15)
 50 DIM B$(14,2)
 51 LET B$(2)=" 2"
 52 LET B$(3)=" 3"
 53 LET B$(4)=" 4"
 54 LET B$(5)=" 5"
 55 LET B$(6)=" 6"
 56 LET B$(7)=" 7"
 57 LET B$(8)=" 8"
 58 LET B$(9)=" 9"
 59 LET B$(10)="10"
 60 LET B$(11)="J "
 61 LET B$(12)="Q "
 62 LET B$(13)="K "
 63 LET B$(14)="A "
 70 LET A=0
 80 LET I=6
 90 FOR P=2 TO 27 STEP 5
100 FOR R=5 TO 7
110 PRINT AT R,P; CHR$ 136; CHR$ 136; AT R+9,P;
    CHR$ 136; CHR$ 136
120 NEXT R
130 NEXT P
140 PRINT AT 5,5; CHR$ 23; AT 14,5; CHR$ 23;
    AT 6,0; CHR$ 146
```

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```
150 PRINT AT 1,2; "TURN OF THE CARDS."
160 PRINT AT 3,2; "player one"; AT 3,20;
    "SCORE ";0
170 PRINT AT 12,2; "player two"; AT 12,20;
    "SCORE ";0
180 IF A>0 THEN GOTO 230
190 LET A=INT(RND*13)+2
200 PRINT AT I,2; B$(A)
210 LET L(I)=A
220 LET P(I)=2
225 LET C(I)=2
230 LET X=INT(RND*13)+2
240 IF INKEY$="L" THEN GOTO 280
250 IF INKEY$="H" THEN GOTO 280
260 IF INKEY$="S" THEN GOTO 500
270 IF INKEY$="C" AND C(I)=2 THEN GOTO 190
275 GOTO 240
280 LET A$=INKEY$
290 LET C(I)=C(I)+5
300 PRINT AT I,C(I); B$(X)
310 IF A$="H" AND X<=A THEN GOTO 400
320 IF A$="L" AND X>=A THEN GOTO 400
330 IF C(I)=27 THEN GOTO 700
340 LET A=X
345 PAUSE 50
350 GOTO 230
400 PAUSE 100
410 FOR W=P(I)+5 TO 27 STEP 5
420 PRINT AT I,W; CHR$ 136; CHR$ 136
430 NEXT W
440 GOTO 560
500 LET L(I)=A
510 LET P(I)=C(I)
520 FOR W=5 TO 30 STEP 5
530 PRINT AT I-1,W; CHR$ 0
540 NEXT W
550 PRINT AT I-1,C(I)+3; CHR$ 23
560 IF I=6 THEN PRINT AT 6,0; CHR$ 0;
    AT 15,0; CHR$ 146
570 IF I=15 THEN PRINT AT 6,0; CHR$ 146;
    AT 15,0; CHR$ 0
580 IF I=6 THEN GOTO 610
590 LET I=6
600 GOTO 620
610 LET I=15
620 LET C(I)=P(I)
630 LET A=L(I)
640 GOTO 180
700 LET S(I)=S(I)+1
705 PRINT AT I-3,26; S(I)
710 IF S(I)=5 THEN GOTO 800
720 FOR P=2 TO 27 STEP 5
730 FOR R=I-1 TO I+1
740 PRINT AT R,P; CHR$ 136; CHR$ 136;
    AT R,P+3; CHR$ 0
750 NEXT R
760 NEXT P
770 PRINT AT I-1,5; CHR$ 23
780 LET C(I)=2
785 LET A=0
790 GOTO 180
800 FOR W=2 TO 30
810 FOR R=I-1 TO I+1
820 PRINT AT R,W; CHR$ 0
830 NEXT R
840 NEXT W
850 PRINT AT I-1,11; "GAME OVER"; AT I+1,8;
    "I AM THE WINNER"
860 PAUSE 200
870 CLS
880 GOTO 5
890 SAVE "CARDS"
900 GOTO 5

(NEGATIVE CHARACTERS SHOWN IN LOWER CASE.)

LINES 50 TO 63 MAY BE ENTERED AS DIRECT
COMMANDS IF THE COMMAND "RUN" IS AVOIDED.
```

Guessing game

J Wise,
Barnet, Hertfordshire.

VIC-20

HERE IS A program for the Vic-20. It will run without any extra memory. I also have some tips for anyone intending to buy a Vic. Before you do, check that the transformer does not have a blue base. These were faulty and should have been returned to Commodore. It should say "Made in Germany" on the box. Ones made in Japan are display models and do not have as high a quality picture. Ask your dealer if it is distributed through Commodore. If it is not, it is likely not to be tuned correctly to suit British TV.

```
1 POKE 36879,27:PRINT"(BLU)"
10 PRINT 2(CLR)GUESSING GAME"
30 PRINT:PRINT:PRINT"I HAVE THOUGH OF A":PRINT"NUMBER BETWEEN 1 AND":PRINT"20.
   YOU MUST TRY AND"
40 PRINT "GUESS IT. I WILL COUNT"
50 PRINT "THE NUMBER OF GUESSES."
55 B=1
60 PRINT:A=INT(RND(1)*20)+1
70 PRINT "GUESS "B;:INPUT C
80 B=B+1
90 IF C<A THEN 500
100 IF C>A THEN 600
110 IF C=A THEN 700
500 POKE 36878,15:POKE 36877,128: FOR X=1 TO 2500: NEXT X
505 POKE 36877,0
510 PRINT"(BLK)(RVS ON)TOO LOW!!!(BLU)"
520 GOTO 70
600 POKE 36878,15:POKE 36875,200:FOR X=1 TO 2500:NEXT X:POKE 36875,0
610 PRINT"(PUR)(RVS ON)TOO HIGH!!!(BLU)"
620 GOTO 70
700 POKE 36878,15:FOR N=1 TO 7:POKE 36875,170:FOR X=1 TO 100:NEXT X:POKE
36875,0:NEXT N
710 PRINT"(BLK)RIGHT! YOU TOOK";B-1;"GUESSES"(BLU)"
711 PRINT"(RVS ON) PRESS ANY KEY"
713 GET T$:IF T$="" THEN 713
714 PRINT"(CLR)";:RUN
```

Lateral Scroll

Darrin Hill,
Saintbridge, Gloucester.

ZX-81

THIS MACHINE-CODE program scrolls the screen from right to left. It will only work on a 16K ZX-81 since it works by Poking on to the screen. The main section scrolls one horizontal line, whilst the section beforehand moves it down the screen until it has all been scrolled. Use this program to enter the machine code a number at a time.

```
10 REM (54Xs)
20 LET A=16514
30 INPUT B
40 POKE A,B
50 PRINT B;",";
60 LET A=A+1
70 GOTO 30
```

Check that those printed on the screen correspond to the code, and when it has all been entered stop the Basic program by entering "P".

Before attempting anything else, enter, as a direct command:

RAND USR (16514)

If, after a few seconds, the computer does not reply with a "0/0" report code, or crashes, then you made a mistake. Otherwise, try this demonstration program, remembering not to delete line 10:

```
10 REM (MACHINE CODE)
20 LET A=10
30 PRINT AT A,31;"*"
40 LET A=A+(INKEY$="6")+(A=0)
   -(A=21)-(INKEY$="7")
50 RAND USR (16514)
60 GOTO 30
```

The asterisk on the right of the screen is moved up by "7" and down by "6". You should find that it forms a tail due to the scrolling.

You do not have to scroll the whole screen. You can isolate it by Poking certain locations.

```
POKE 16530,A
POKE 16531,B
POKE 16515,C
POKE 16516,D
```

A=231, B=0, C=0 and D=0 confine it to the top 7 lines. A=214, B=2, C=231 and D=0 confine it to the bottom 13 lines. A=74, B=1, C=231 and D=0 keep it in the centre and, so that the whole screen is scrolled again, A=214, B=2, C=0 and D=0.

To decide on your own extremes Poke into 16530 and 16531 the hexadecimal values of a number between 0 and 22 multiplied by 33 and adding 33 to the answer. This sets the lower line. In all cases it must be greater than the next value, which is a number between 0 and 22 multiplied by 33 and its hexadecimal values Poked into 16516 and 16515.

Finally, since the program only scrolls from right to left it can be altered so that it works in the opposite direction.

```
POKE 16530,0
POKE 16531,0
POKE 16515,214
POKE 16516,2
POKE 16536,1
POKE 16537,33
POKE 16538,0
POKE 16539,237
POKE 16540,66
POKE 16553,43
POKE 16554,43
POKE 16562,35
```

DECIMAL	Z80 ASSEMBLER	COMMENTS
17,0,0	LD DE,0	
98	LD H,D	LETS
107	LD L,E	HL=DE
175	XOR A	
125	LD A,L	POKES L
50,164,64	LD(16548),A	INTO 16548
175	XOR A	.
124	LD A,H	POKES H
50,165,64	LD(16549),A	INTO 16549
1,214,2	LD BC,726	IF
237,66	SBC HL,BC	HL=726
200	RET Z	THEN RETURN
98	LD H,D	
107	LD L,E	
1,33,0	LD,BC,33	INCREASES
9	ADD HL,BC	HL BY 33
84	LD D,H	STORES VALUE
93	LD E,L	OF HL IN DE
237,75,12,64	LD BC,(D FILE)	
33,0,0	LD HL,0	
9	ADD HL,BC	
175	XOR A	
60	INC A	
35	INC HL	
35	INC HL	
254,32	CP 32	IF A=32 THEN
40,7	JR Z,7	JUMP 7
70	LD B,(HL)	LETS B=GRAPHIC
54,0	LD(HL),0	CLEARS GRAPHIC
43	DEC HL	POKES GRAPHIC IN
112	LD(HL),B	NEW POSITION
24,242	JR NEXT	
24,205	JR NEXT	

Enterprise rescue

D E Healey,
Coseley, West Midlands.

ZX-81

A FEDERATION starbase has been destroyed by a Klingon attack and the USS *Enterprise* has just arrived in the sector to pick up survivors. You must guide the life capsules containing the survivors into the cargo deck of the *Enterprise.* The capsules have limited oxygen supplies so you must act as quickly as possible. Beware of space mines!

You guide the capsules to the *Enterprise* by using the keys "1", ".", "A" and "P" which move it up, down, left, and right respectively.

You score for each capsule collected and gain time. The game ends either when you run out of time or when one of the capsules hits an invisible space mine.

```
10 LET E=13
20 LET T=200
30 LET S=PI-PI
40 LET Y=2
50 LET X=Y
60 LET A=PI/PI
90 CLS
100 LET H=INT(RND*E)
110 LET I=INT(RND*E)
120 PRINT AT H,I;"graphic 7 graphic Q graphic E graphic 1"
130 LET J=INT(RND*E)
140 LET K=INT(RND*E)
150 LET T=T-2
160 IF T=PI-PI THEN GOTO 600
200 PRINT AT Y,X;"+"
210 IF Y=J AND X=K THEN GOTO 500
220 IF Y=H AND X=I THEN GOTO 400
230 PRINT AT Y,X;" space"
240 IF INKEY$="1" THEN LET Y=Y-A
250 IF INKEY$="." THEN LET Y=Y+A
260 IF INKEY$="A" THEN LET X=X-A
270 IF INKEY$="P" THEN LET X=X+A
280 IF Y<PI-PI THEN LET Y=PI-PI
290 IF X<PI-PI THEN LET X=PI-PI
300 IF X>19 THEN LET X=19
310 GOTO 130
400 LET S=S+5
410 IF INT(RND*16)=E THEN LET T=T+90
420 LET T=T+10
430 CLS
440 PRINT T
450 PAUSE 30
460 GOTO 90
500 PRINT AT Y,X-A;">*<"
510 PAUSE E
600 CLS
610 PRINT S
```

On the dump

C Perry,
Farnborough, Hampshire.

MZ-80K

MY PROGRAM dumps memory on to the screen of the MZ-80K and should be useful for anyone trying to write machine-code subroutines. The program was written in machine code to make it faster and to exploit the monitor subroutines to the full. All the numbers used by the program are either two- or four-character hexadecimal numbers.

When you run the program, there is a short delay as the machine code is loaded into the memory. The computer will then print:

ADDRESS ?

The computer is asking for a four-character hexadecimal number from which you want memory to be dumped. For example:

ADDRESS ?
D000 (CR)

The computer will respond to this by showing a flashing cursor. This tells you that the computer is waiting for a command key to be pressed. There are five key commands, and it

(continued on next page)

(continued from previous page)

is easy for anybody with even a small knowledge of machine-code programming to add others. The commands are:

(SHIFT) X

This dumps memory from the predefined address in the form

D000 01 00 FF 10 2F 3C 5A 95

The flashing cursor then reappears showing that the program is waiting for the next key command. If the shift-X key is then pressed again, the next eight bytes of memory will be displayed:

D008 00 F6 CF 49 1A CD 00 4D

The command C allows you to redefine the address that you wish to dump. The shift-E command allows you to edit the information you have dumped. In this mode, full screen editing is supported. When you have modified a line the CR key must be pressed or the change in the memory will not be made. The editing mode is a closed loop so that control does not return to the main program after the CR key has been pressed. The only way to leave the editing mode is to press shift-break, to return to the main part of the program where the key commands can be used.

Shift G will call a machine-code subroutine. The starting address of the subroutine should be entered using the C command, and then the shift-G command must be pressed. No other command keys should be used between these two commands as they will alter the start address. Return from a subroutine is via the normal Z-80 return codes.

```
C.PERRY   MEMORY DUMP FOR THE MZ-80K

10 DATA 65,68,68,82,69,83,83,32,63,13
20 DATA 17,80,18,205,21,0,205,6,0
30 DATA 17,0,18,205,3,0,205,16,4,205
40 DATA 179,9,254,18,32,1,201,254,3,32
50 DATA 3,0,24,222,254,88,32,20,205,186
60 DATA 3,6,8,205,12,0,126,205,195,3
70 DATA 35,16,246,205,9,0,24,216
80 DATA 254,69,32,33
90 DATA 17,0,18,205,3,0,205,30,0,40,239
100 DATA 205,16,4,19,19,19,19,19,6,8
110 DATA 205,31,4,119,19,0,35,16,246
111 DATA 0,24,223
115 DATA 254,71,32,3,205,0,0,24,208,233,0,0,0
200 LET M=24: REM *** USER MEMORY OF MACHINE ***
210 LET M=M+4: REM *** ADD 4 FOR 4K MONITOR ROM ***
220 LET M1=1024*M: REM *** TOP OF USER MEMORY ***
225 LIMIT (M1-202)
230 FOR A=M1-120 TO M1-5
240 READ B: POKE A,B
250 NEXT A
270 L=M1-120: L1=M1-200: LH=INT(L/256): LL=INT(L-256*LH+0.5)
280 POKE L+11,LL: POKE L+12,LH
290 LH=INT(L1/256): LL=INT(L1-256*LH+0.5)
300 POKE L+20,LL: POKE L+21,LH
310 POKE L+72,LL: POKE L+73,LH
311 LH=INT((M1-7)/256): LL=INT((M1-7)-256*LH+0.5)
312 POKE (M1-11),LL: POKE (M1-10),LH
320 USR(L+10)
330 END
```

Fighter pilot

C M Medley,
Stapleford, Nottingham.

ZX-81

IN THIS GAME you are a fighter pilot trying to repel an invasion by enemy aircraft. You have a total of five aircraft armed with air-to-air missiles. Each enemy plane shot down increments your score by one. Missed planes are also counted. If you crash your aircraft into the enemy, or delay firing too long and are caught in the blast of your own missile, you lose that aircraft. Your score will include the aircraft brought down by collison.

Keys 6 and 7 manoeuvre the aircraft in the direction of the cursors, 0 fires the missile. As the program only tests whether a key is being pressed once each cycle, the keys should be held down. The logic in line 130 is to prevent an aircraft skipping over the missile. This program is written for the ZX-81 with 16K RAM. However, if the frills are removed, you could use the basic idea on a standard machine.

```
10   LET S=0
20   LET C=0
30   LET A=1
40   LET FX=27
50   LET FY=10
60   LET EX=0
70   LET EY= INT(RND*20)+1
80   LET C=C+1
90   LET Y=FY
100  LET X=FX
110  CLS
120  PRINT AT FY,FX; "[graphics]" - Graphics/Shift/6,#,6,Q.
130  IF Y=EY AND (X=EX+1 OR X=EX+2 OR X=EX+3) THEN GOTO 270
140  PRINT AT EY,EX; "[graphics]" - Graphics/Shift/W,6,F,6.
150  LET EX=EX+2
160  IF EX>27 THEN GOTO 60
170  LET A$=INKEY$
180  IF A$= "6" AND FY<20 THEN LET FY=FY+1
190  IF A$= "7" AND FY>0 THEN LET FY=FY-1
200  IF A$= "0" OR X<27 THEN LET X=X-1
210  IF A$= "Q" THEN GOTO 500
220  IF X<27 AND X>0 THEN GOSUB 250
230  IF X<27 AND X>EX THEN GOTO 110
240  GOTO 90
250  PRINT AT Y,X; "<="
260  RETURN
270  IF EX<=23 THEN PRINT AT 0,0;"AIRCRAFT DESTROYED."
280  LET S=S+1
290  IF EX>23 THEN PRINT AT 0,0;"YOU DESTROY ATTACKING AIRCRAFT",
     "BUT YOU ARE ALSO DESTROYED."
300  PRINT "YOU HAVE BROUGHT DOWN: ",,S;" AIRCRAFT,";
310  IF C-S=0 OR C-S>1 THEN PRINT TAB 16;C-S;" HAVE ESCAPED."
320  IF C-S=1 THEN PRINT TAB 16;C-S;" HAS ESCAPED."
330  FOR N=1 TO 100
340  NEXT N
350  IF EX>23 THEN GOTO 370
360  GOTO 60
370  LET A=A+1
380  IF A=6 THEN GOTO 440
390  PRINT
400  PRINT "DO YOU WISH TO SCRAMBLE","FIGHTEER NO.";A;"? (Y/N)"
410  INPUT B$
420  IF B$<>"Y" THEN GOTO 490
430  GOTO 60
440  PRINT
450  PRINT "ALL FIGHTERS HAVE BEEN SCRAMBLED";"DO YOU WISH TO TRY
     AGAIN? (Y/N)"
460  INPUT C$
470  IF C$<>"Y" THEN GOTO 490
480  RUN
490  CLS
500  STOP
```

Keyboard reverse

Derek Robinson,
Bradford,
West Yorkshire.

ZX-81

THIS PROGRAM effectively reverses the keyboard thus enabling Inkey$ to operate on the graphic symbols so that they can be printed rapidly in a continuous manner without resort to the shift key. With my software, printing graphics can be controlled by a program, or by the cursor keys. This makes unlimited picture drawing possible.

The symbols can be changed directly by pressing the key bearing the symbol required. Alternatively, they can be interchanged with the normal Inkey$ character, or erased by a flashing screen cursor, again, repeatedly and without limit.

To run the second program — N may be larger or smaller than 10 — input pairs of code numbers to correspond to the two symbols on the selected keys.

Enter the graphics-symbols code first and having input N pairs, the screen will clear. Depress the symbol you require and it will appear on the screen. You can print it repeatedly leaving a trail of the symbol in the direction selected by the cursor including, 4,9,T and U — 45° movement.

To change to another graphic symbol, press M followed by the symbol key. To erase, press Rubout then a movement cursor; to change to the normal character key or vice versa, press the full stop.

```
DEREK ROBINSON   PICTURE PRINTER
10 REM GRAPHIC SYMBOL PRINTER
20 REM COPYRIGHT DEREK ROBINSON
30 LET A$=CHR$38
40 LET B$=CHR$8
50 IF INKEY$="A" THEN PRINT B$
60 GOTO 50
5 REM PICTURE PRINTER
6 REM COPYRIGHT DEREK ROBINSON
10 DIM A$(10)
20 DIM B$(10)
30 DIM C$(10)
40 FOR N=1 TO 10
50 INPUT G
60 INPUT H
70 LET A$(N)=CHR$G
80 LET B$(N)=CHR$H
90 PRINT TAB 1;A$(N) TAB6;B$(N)
```

```
100 NEXT N
110 CLS
120 LET X=0
130 LET Y=0
140 LET Z=1
150 FOR N=1 TO 10
160 IF INKEY$=B$(N) THEN GOTO 190
170 NEXT N
180 GOTO 150
190 LET C$(N)=A$(N)
200 LET U$=INKEY$
210 IF U$="T" OR U$="5" OR U$="4" THEN LET
X=X-(X>Z)
220 IF U$="U" OR U$="8" OR U$="9" THEN LET X=X+(X<31)
230 IF U$="T" OR U$="6" OR U$="U" THEN LET Y=Y+(Y<21)
240 IF U$="4" OR U$="7" OR U$="9" THEN LET Y=Y-(Y>Z)
250 IF U$="M" THEN GOTO 160
260 IF U$="0" THEN LET C$(N)=" "
270 IF U$="." THEN LET C$(N)=B$(N)
280 PRINT AT Y,X;B$(N); AT Y,X;C$(N)
290 GOTO 200
```

Atom art

Martin Campbell,
Barlanark, Glasgow.

ATOM

I HAVE WRITTEN a program which allows you to draw pictures in high resolution. The assembler at the start is used as a Inkey$ function.

The main loop is from lines 25 to 300. Lines 40 to 140 determine what keys are being pressed and then branch to the appropriate subroutine. Instructions are also included but these can be left out if you are short of memory.

```
0 REM ATOM ART
1 P. $21;P=#21C
2[JSR#FE71;BCS P+9;JSR P+11
3 STA  #032C;RTS;LDA @#FF;BNE P-6
4 PHP;JMP#FEA7;];P.$6;K=0
5 Z=13;G=1;P.$12
10 IN."'STARTING POINTS"X,Y .
11 GOSUB 1000
20 CLEAR 4
25 LINK #21C
26 F.L=0 TO 6; N.L
30 PLOT Z,X,Y
40 IF K=65 G.a
50 IF K=81 G.q
60 IF K=87 G.w
70 IF K=69 G.e
80 IF K=68 G.d
90 IF K=67 G.c
100 IF K=88 G.x
110 IF K=90 G.z
120 IF K=48 G.20
130 IF K=49 G.o
140 IF K=50 G.t
150 G.25
200aX=X-1;G.25
210qX=X-1;Y=Y+1;G.25
220wY=Y+1;G.25
230eX=X+1;Y=Y+1;G.25
240dX=X+1;G.25
250cX=X+1;Y=Y-1;G.25
260xY=Y-1;G.25
270zX=X-1;Y=Y-1;G.25
280oZ=13;G.25
290tZ=15;G.25
300 G.25
1000 P."              ATOM ART"'"              ---------"''
1010 P." THIS PROGRAM ALLOWS YOU TO DRAW PICTURES WITH THE ATOMS HIGH"
1020 P." RESOLUTION GRAPHICS."'
1030 P." USE THE KEYS AROUND 'S' TO DRAW"''
1040 P." PRESS '1' TO DRAW "''
1050 P." PRESS '2' TO RUBOUT"''
1060 P." PRESS RETURN PLEASE "'
1070 LINK#FFE3
1080 P.$12
1090 P.'''"IF YOU WANT TO DRAW SLOW THEN"'
2000 P." PRESS '8' OR IF YOU WANT TO"'
2010 P." DRAW FAST THEN PRESS '9' "'
2020 P." PRESS '0' TO RESTART"
2030 P.'" PRESS ANY KEY TO START.";LINK#FFE3;RETURN
```

Basic truth

P J Newbury,
Croydon, Surrey.

ZX-81

PAUL BRITTAIN'S "Free memory" machine-code program — Software File, November 1981 — can be entered very simply by using Basic characters in place of the decimal machine-code instructions. All you do is enter the following line:

1 REM j,?,?,T,GOSUB,?,0,RND,GOSUB,PI,
FAST,AT,CLEAR,5,s,RND,Y,2,GOSUB,?,TAN

Where j means inverse J and s means space. The commas are only for clarity and are not part of the line. To enter keywords use Then, the keyword and thirdly edit out Then using the cursor position keys followed by Rubout.

After entering this line with Newline, enter the following as direct commands:

POKE 16515,103
POKE 16516,111
POKE 16519,75
POKE 16533,71

The program is ready for use at any time by:

PRINT USR 16514

It is useful to have this program in the machine whenever you are writing a program. By saving it on tape, you can enter it before your program. Just remember not to use line 1 in your program. The four Poke commands will have to be entered each time you load it.

The lack of Read and Data statements in ZX-81 Basic can be most frustrating. The most common use for such commands is to get the Nth number from a list of numbers. Here is one solution to the problem.

Each number in the list must have the same number of characters including the sign and any decimal point. This can easily be achieved with a few extra zeros. The two program lines are:

LET A$ = "(your list of numbers entered one after the other)"
LET Z = VAL A$((N-1)*X + 1 TO (N-1)*X + X)

X is the number of characters in each number. Any additional zeros included to make every number the same number of characters are removed by the Val statement. N can, of course, be changed to any other variable convenient to your program, as can Z.

Piano keys

Nalin Sharma,
London E17.

VIC-20

THIS PROGRAM will allow you to play all 38 notes shown on page 135 of the Vic-20 manual. The keys which can be used begin from the second row down:

Q W E R T Y U I O P @ *
A S D F G H J K L : ; = (Ret)
Z X C V B N M , . /

As the cursor keys are used: line 6 stops them repeating and so when you break the program a Poke 650,0 will restore the normal repeat functions. If you want silence, hit the space bar — line 100.

A feature of the program is that although you choose your voice at the beginning, you can change it in the middle of the program by pressing 1,2,3 or 4 to obtain the respective voice — line 85.

```
6 POKE 650,127
10 PRINT "VIC 20 PIANO KEYS"
20 INPUT "WHICH VOICE";S
30 IF S<1 OR S>4 THEN 20
40 S=INT(S)+36873
50 POKE 36878,15
55 DIM A(100)
60 READ N:IF N=0 THEN 80
70 READ A(N)
75 GOTO 60
80 GET A$:IF A$="" THEN 80
85 IF A$="1" OR A$="2" OR A$="3" OR A$="4" THEN GOSUB 180:GOTO 80
90 N=ASC(A$)
100 IF N=32 THEN POKE S,0:GOTO 80
110 POKE S,0
120 FOR T=1 TO 10:NEXT
130 POKE S,A(N)
140 GOTO 80
150 POKE S,0
180 POKE S,0:K=VAL(A$):S=K+36873:RETURN
200 DATA 81,135,87,143,69,147,82,151,84,159,89,163,85,167,73,175
210 DATA 79,179,80,183,64,187,42,191,92,195,65,199,83,201,68,203
220 DATA 70,207,71,209,72,212,74,215,75,217,76,219,58,221
230 DATA 59,223,61,225,13,227,90,228,88,229,67,231,86,232,66,233
240 DATA 79,235,77,236,44,237,46,238,47,239,17,240,29,241,0
```



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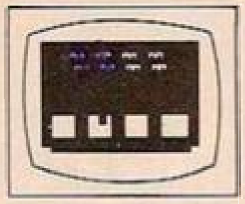
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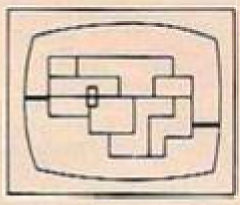
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BY ANTHONY ROBERTS

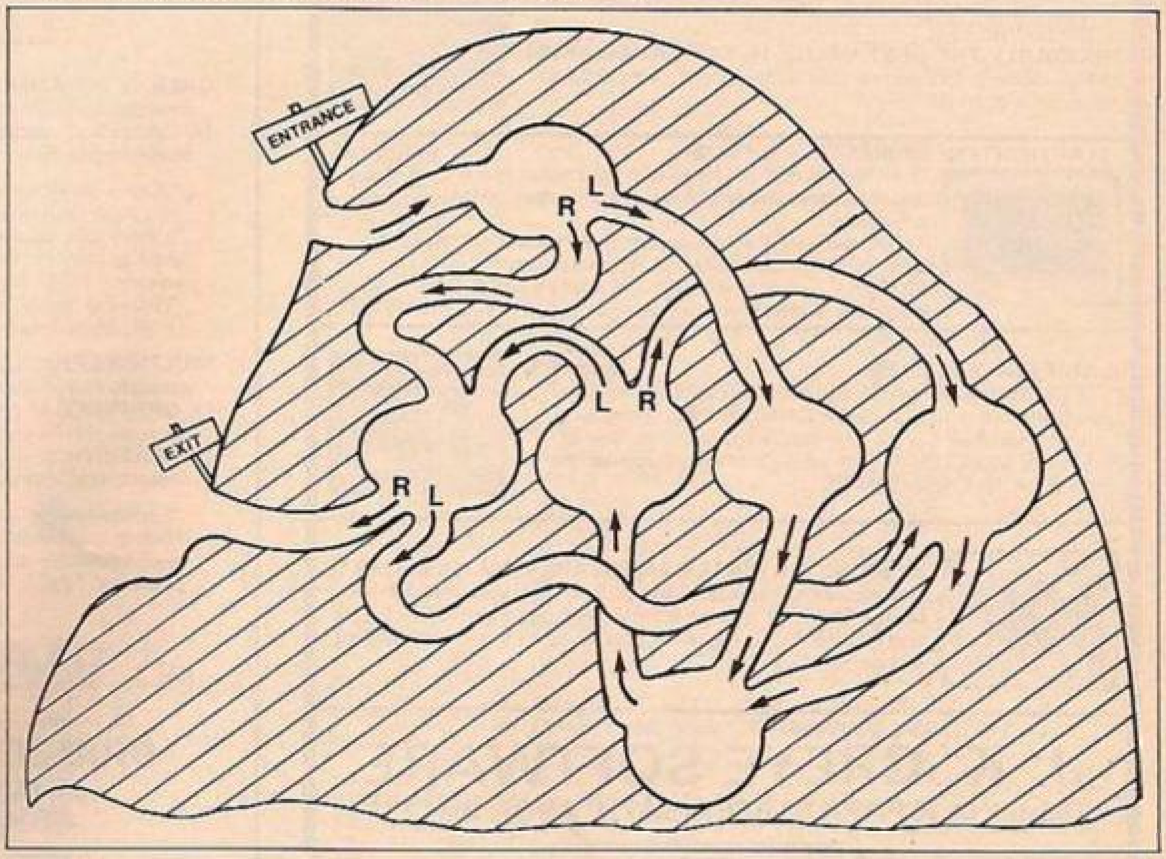
THE WIZARD One-eye has you in straits again. He has you and 24 others herded into a cage outside the Troll's Tor — a cave system in which each cave contains a troll, a pile of bones and a chest of gems. The trolls, curiously, have been numbered 1,2,3,4,5 and 6 by branding iron, and each will give the cave traveller that many gems as he passes through his cave. The wizard simply wants you to enter the caves, wander around and leave with some of the trolls' gems.

As you may have guessed, there are several catches: each troll eats every third person to go through his cave. When he does so, though, he reclaims any gems the traveller may have. If there are more gems than the troll started with, he leaves the excess jewels in a pile in the middle of the cave and goes to sleep. So if you meet a sleeping troll you may take these gems and continue on your way. Invariably though, the troll wakes just as you leave, ready for the next man to pass.

All passages are one-way, and you must always take the left exit of a cave if you have an even number of gems, or the right if you have an odd number — in those caves that have two exits.

You have the cave map but you do not know which troll each cave contains. You see the first four men disappear, then one escapes with five gems, then two men disappear, then the eighth makes it with 35 gems and the tenth with five. You, of course, see that you must go in as the 17th, 22nd, or 24th man in order to survive.

How many gems did the wizard obtain in total?



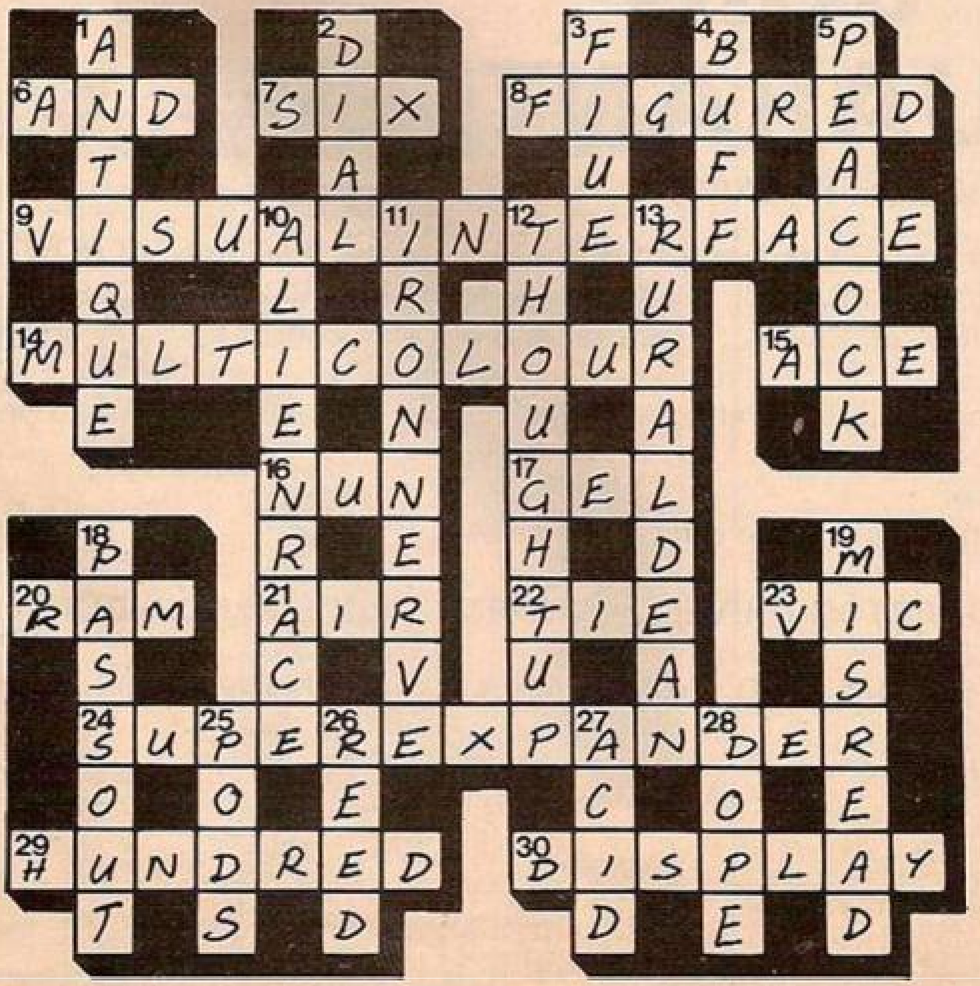
A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in March. The name of the winner, the solution, and a competition report will be published in the May issue of *Your Computer*.

If you want to set a competition for Competition Corner, remember that the simplest solution should be calculable by a short program rather than by any other form of reckoning.

Competition reports

THE JANUARY Vic-20 crossword competition drew a large response. Most of you found the correct solution with little difficulty, and exercised considerable ingenuity in completing the sentence "I did not have to return the power supply on my Vic-20, but . . .". Deciding on a winner was not easy, but after some debate we picked Alan Westwood of 97 Trentham Street, Southfields, London SW18 5DH, for his "Veni, vidi, Vic Twenty". A Vic-20 is on its way.

The January crossword solution.



The last word on the subject goes to Andrew Bennett of Pembroke College, Cambridge, who revealed "My psychiatrist told me I should".

The Orc's Egg competition published in our January issue had one slight flaw — it was insoluble.

The mistake in the puzzle was the instruction "Find a gem lying on the floor" in the cave between the Orc and the Troll. The instruction should have read "Exchange a coin for a gem lying on the floor".

The solution to the corrected puzzle lies in the equation $\sum A = 2^A - 100$. The answer to this equation is A = 7, so the number of gems needed to escape from One-Eye is $\sum 7$ or 28. A simple program to solve this puzzle is:

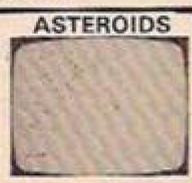
```
10 N=1:D=1
20 S=((N+1)*N/2)+100:D=D*2
30 IF S=D then 50
40 N=N+1:GOTO 20
50 PRINT "BORROW ";S-100;"GEMS"
60 END
```

Despite the error in the puzzle, most of you realised that the answer we were looking for was 28, though T Bate of Lympstone, Devon, produced a solution of 1,002 gems. The neatest solution was provided by Margaret Evans of The Coppins, Stocks Bank Road, Mirfield, Yorkshire WF14 0ES. She accidentally dropped a coin when collecting the Orc's Egg, enabling her to escape safely. A £15 book token is on its way to her.

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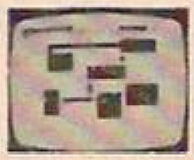
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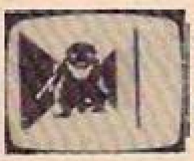
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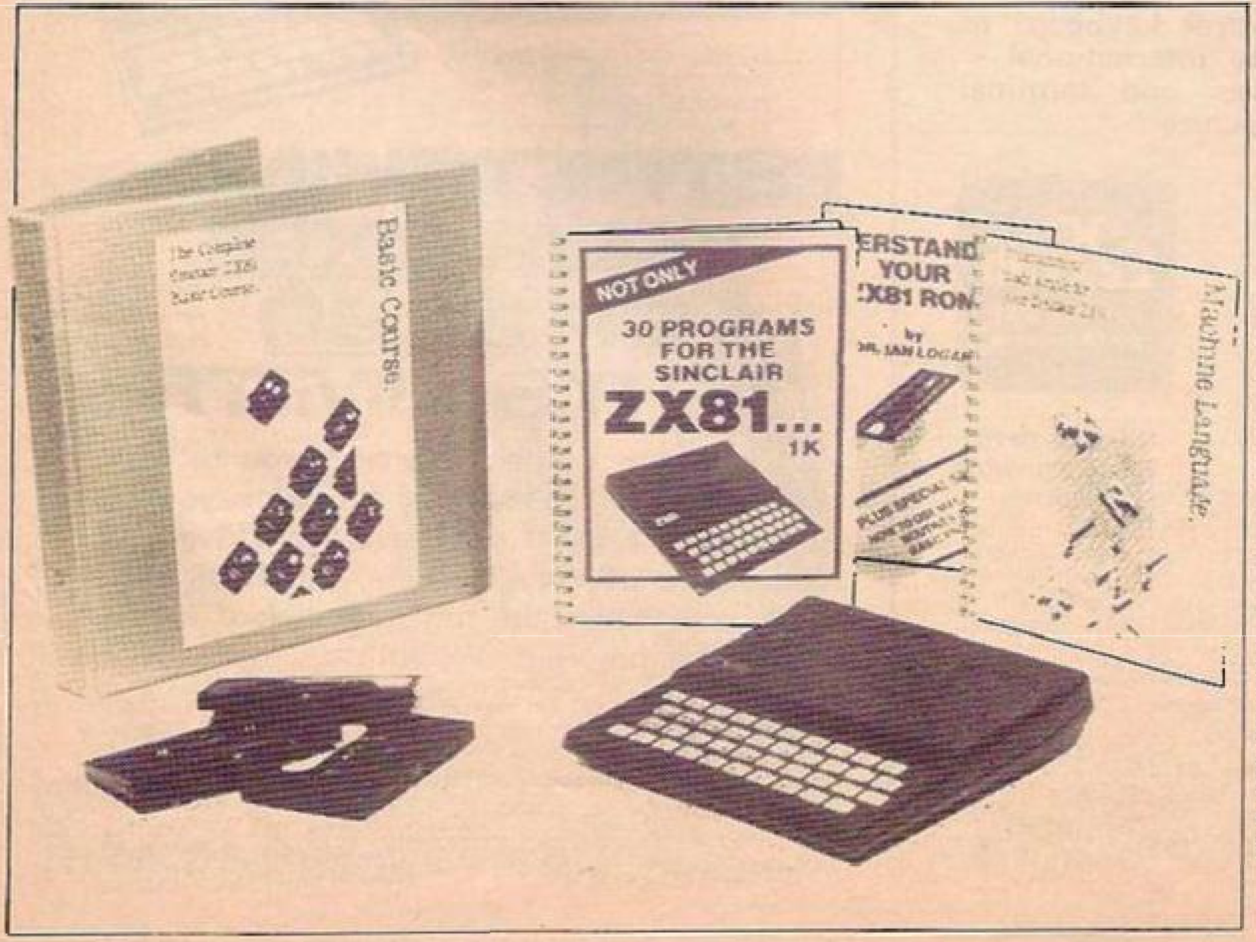
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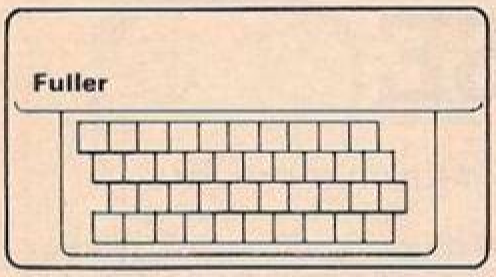
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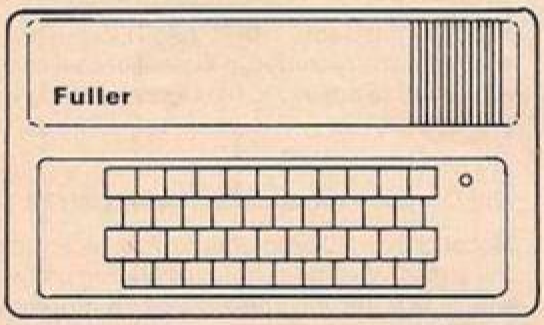
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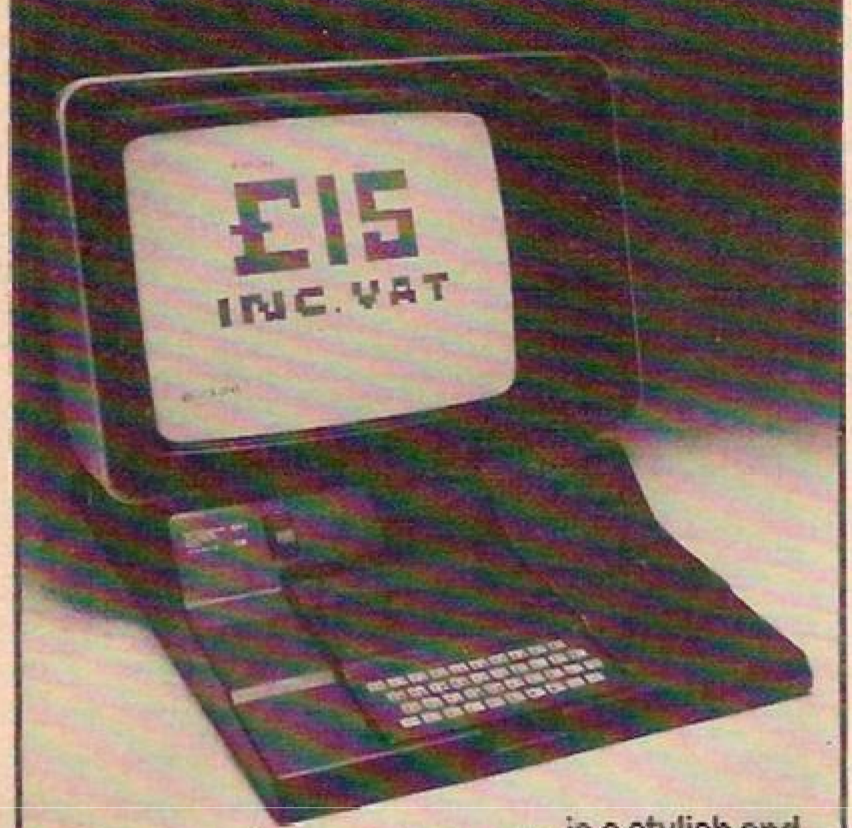
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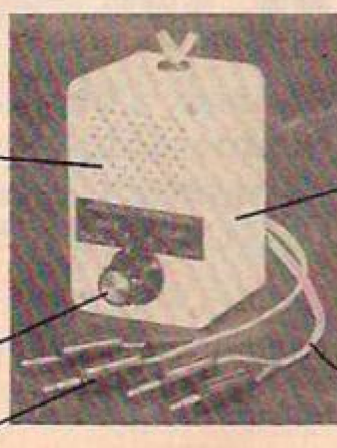
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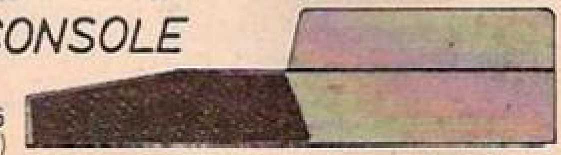
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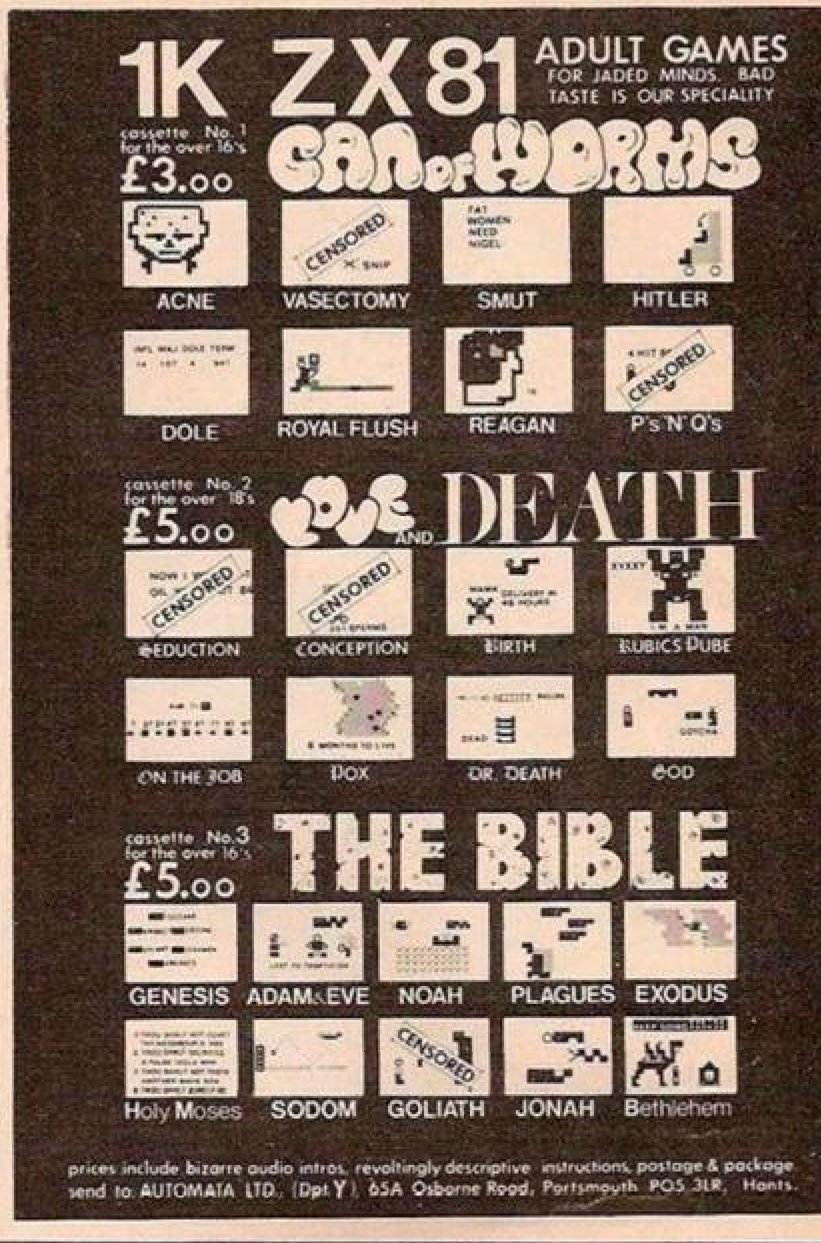
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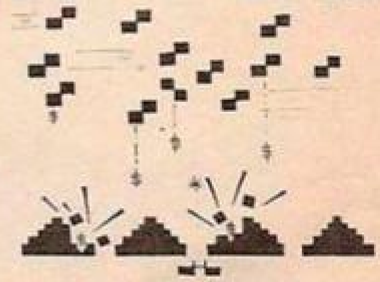
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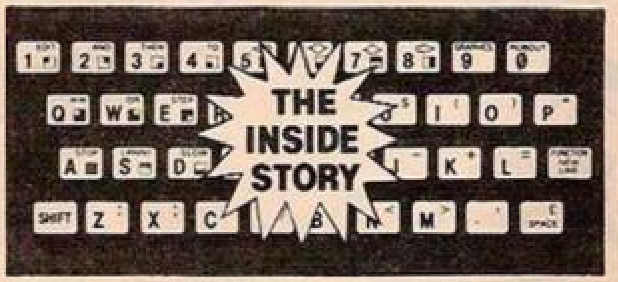
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THE ZX81 COMPANION



Bob Maunder

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THE ZX81 COMPANION was reviewed in the September 1981 issue of the Educational ZX80/81 Users' Group Newsletter as follows:

Bob Maunder's ZX80 Companion was rightly recognised to be one of the best books published on progressive use of Sinclair's first micro. This is likely to gain a similar reputation. In its 130 pages, its author does not go as far as he did before, but his attempt to show meaningful uses of the machine is brilliantly successful.

The book has four sections, with the author exploring in turn interactive graphics (gaming), information retrieval, educational computing, and the ZX81 monitor. In each case the exploration is thoughtfully written, detailed, and illustrated with meaningful programs. The educational section is the same — Bob Maunder is a teacher — and here we find sensible ideas, tips, warnings and programs too. The monitor listing (0000 to 0CB9), while unique, is less fully backed up, and will be of no use to the ZX81 beginner without some knowledge of Z-80 assembly.

To conclude — this book is definitely an outstandingly useful second step for the ZX81 user.

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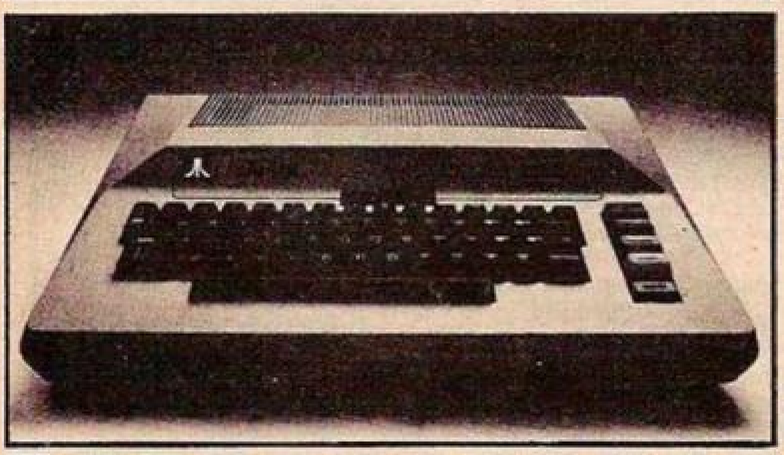


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Sinclair ZX81 ★ NEW RELEASES ★

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Turn your ZX81 into a telescope! The program will produce a simulation of the night sky as seen from any chosen position on Earth at any chosen time this century. You can point your "telescope" in any chosen direction, move it up, down left or right; zoom in or pull out and display the stars by magnitude or constellation.

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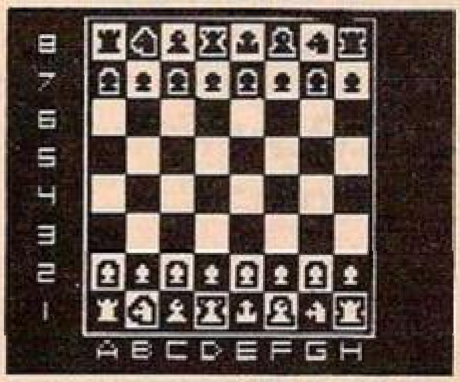
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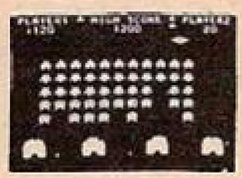


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The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

Sinclair has undertaken to publish the most elegant of these on pre-recorded cassettes. Each program is carefully vetted for interest and quality, and then grouped with other programs to form a single-subject cassette.

Each cassette costs £3.95 (including VAT and p&p) and comes complete with full instructions.

Although primarily designed for the Sinclair ZX81, many of the cassettes are suitable for running on a Sinclair ZX80 – if fitted with a replacement 8K BASIC ROM.

Some of the more elaborate programs can be run only on a Sinclair ZX Personal Computer augmented by a 16K-byte add-on RAM pack.

This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

8K BASIC ROM

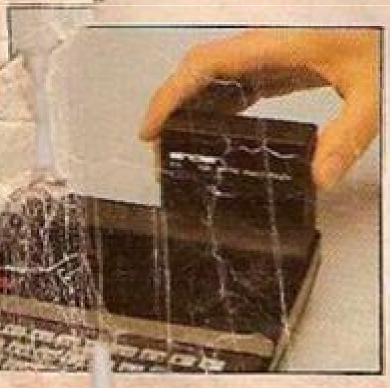
The 8K BASIC ROM used in the ZX81 is available to ZX80 owners as a drop-in replacement chip. With the exception of animated graphics, all the advanced features of the ZX81 are now available on a ZX80 – including the ability to run much of the Sinclair ZX Software.

The ROM chip comes with a new keyboard template, which can be overlaid on the existing keyboard in minutes, and a new operating manual.

16K-BYTE RAM pack

The 16K-byte RAM pack provides 16-times more memory in one complete module. Compatible with the ZX81 *and* the ZX80, it can be used for program storage or as a database.

The RAM pack simply plugs into the rear of the existing expansion port on the rear of a Sinclair ZX Personal Computer.



Cassette 1 – Games

For ZX81 (and ZX80 with 8K BASIC ROM)

ORBIT – your space craft's mission is to pick up a very valuable cargo that's in orbit around a star.

SNIPER – you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

METEORS – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE – J. H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

WOLFPACK – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

GOLF – what's your handicap? It's a tricky course but you control the strength of your shots.

Cassette 2 – Junior Education: 7-11-year-olds

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

TRAIN – multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS – fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

SPELLING – up to 500 words over five levels of difficulty. You can even change the words yourself.

Cassette 3 – Business and Household

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

TELEPHONE – set up your own computerised telephone directory and address book. Changes, additions and deletions of up to 50 entries are easy.

NOTE PAD – a powerful, easy-to-run system for storing and retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or a directory.

BANK ACCOUNT – a sophisticated financial recording system with comprehensive documentation. Use it at home to keep track of 'where the money goes,' and at work for expenses, departmental budgets, etc.

Cassette 4 – Games

For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

LUNAR LANDING – bring the lunar module down from orbit to a soft landing. You control attitude and orbital direction – but watch the fuel gauge! The screen displays your flight status – digitally and graphically.

TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE – tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

AVERAGES – what's the average height of your class? The average shoe size of your family? The average pocket money of your friends? The computer plots a bar chart, and distinguishes MEAN from MEDIAN.

BASES – convert from decimal (base 10) to other bases of your choice in the range 2 to 9.

TEMP – Volumes, temperatures – and their combinations.

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